Peptide 1
"WNE 288-301"
N terminus – C-R-V-K-M-E-K-L-Q-L-K-G-T-T – C terminus
14 amino acid residues

FIG. 1

Peptide 2
"Random 288-301"
N terminus – C-Q-L-L-M-R-E-V-K-T-G-T-K-K – C terminus
14 amino acid residues

FIG. 2

Peptide 3
"WNE 121-139"
N terminus – C-S-T-K-A-I-G-R-T-I-L-K-E-N-I-K-Y-E-V – C terminus
19 amino acid residues

FIG. 3

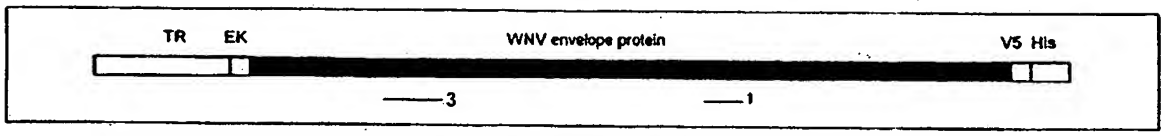


FIG. 4

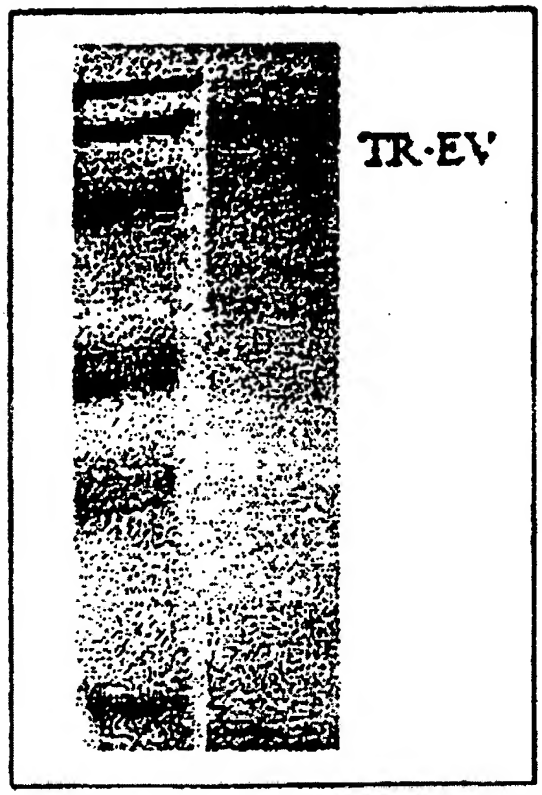


FIG. 5

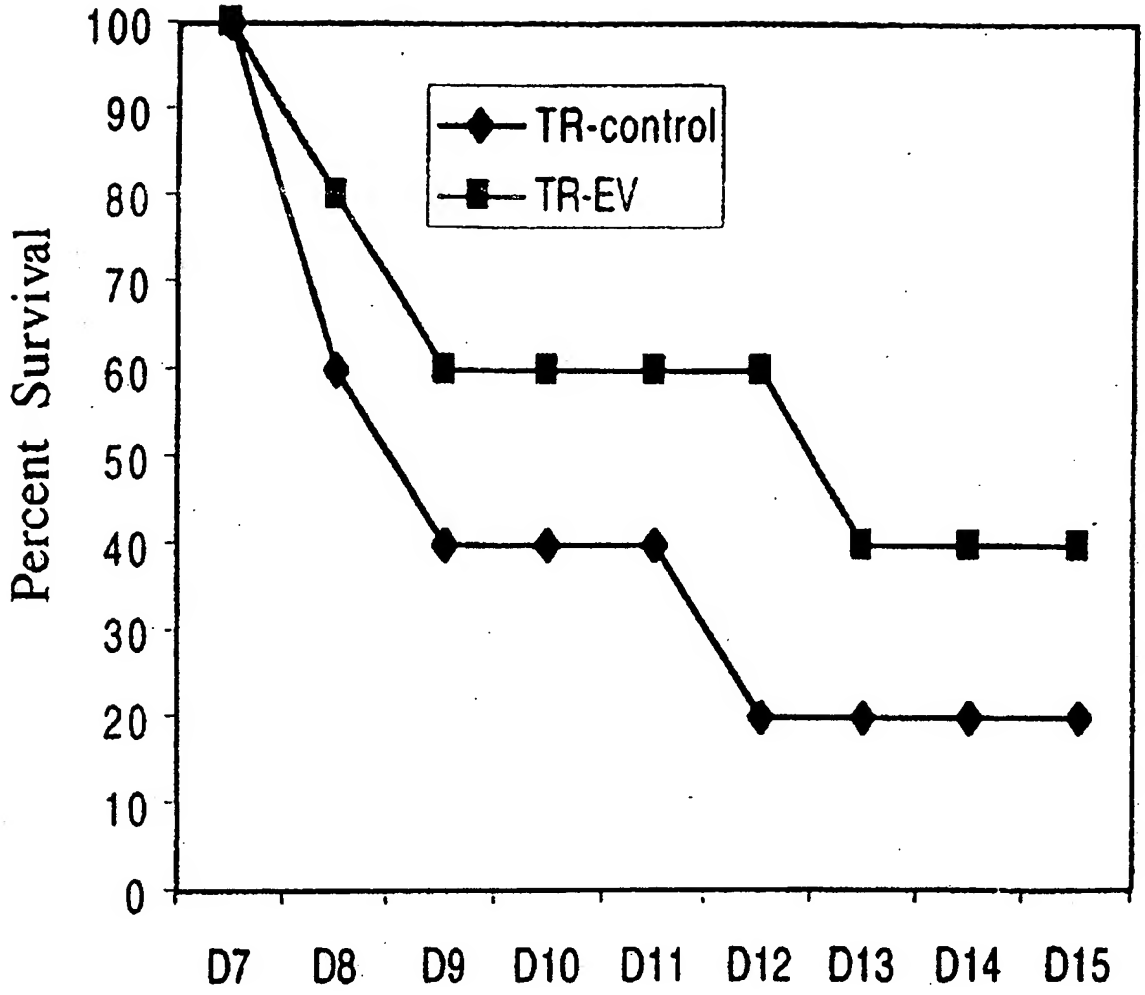
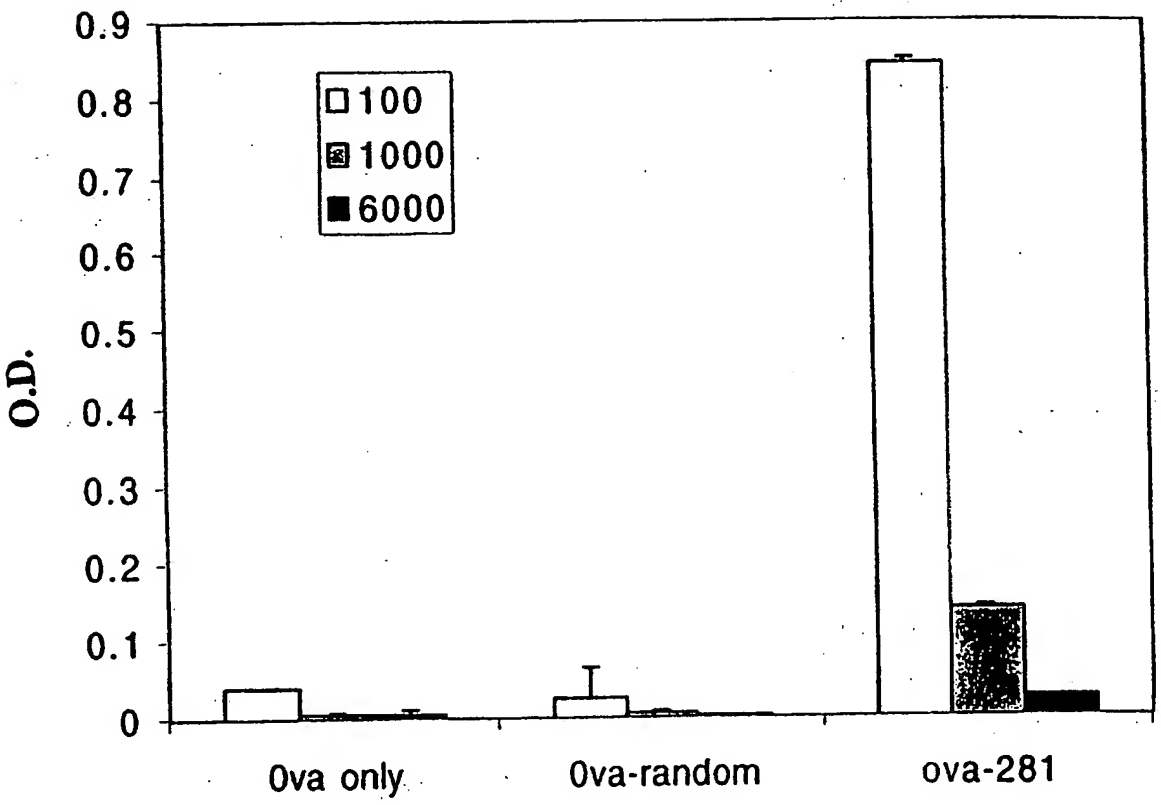

Percent Survival
100
90
80
70
60
50
40
30
20
10
0
TR-control
TR-EV
D7
D8
D9
D10
D11
D12
D13
D14
D15

FIG. 6



mouse serum(TR-EV1) day 21

FIG. 7

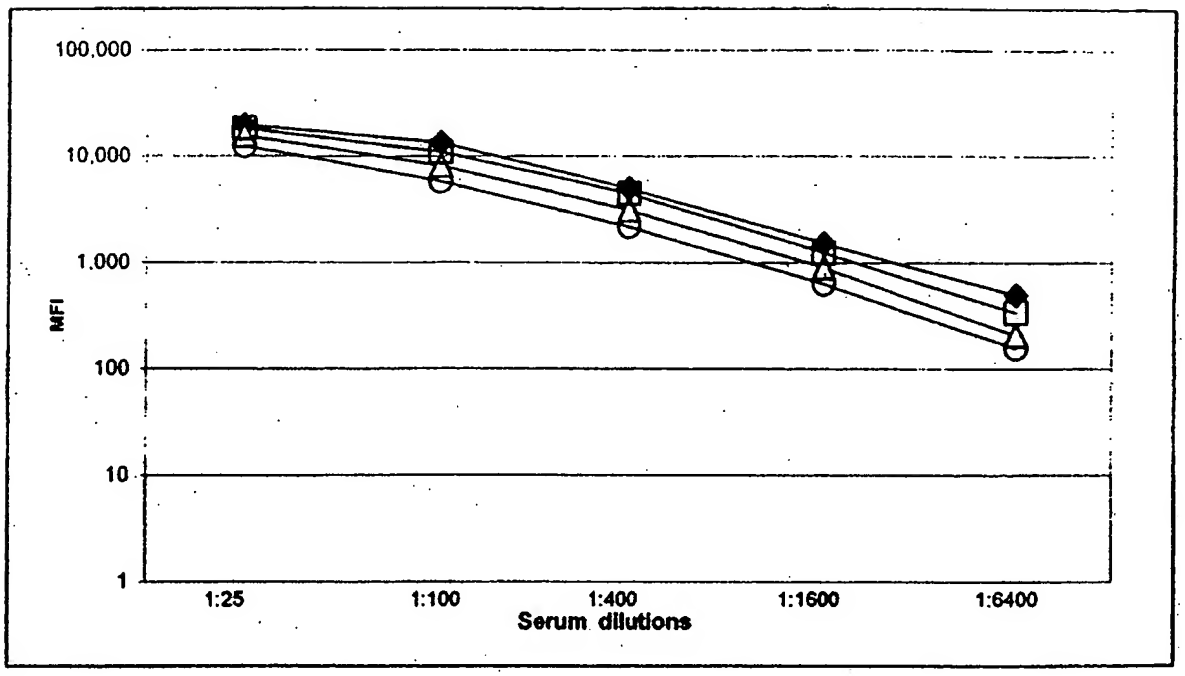

100,000
10,000
1,000
100
10
1
MFI
1:25
1:100
1:400
1:1600
1:6400
Serum dilutions

FIG. 8

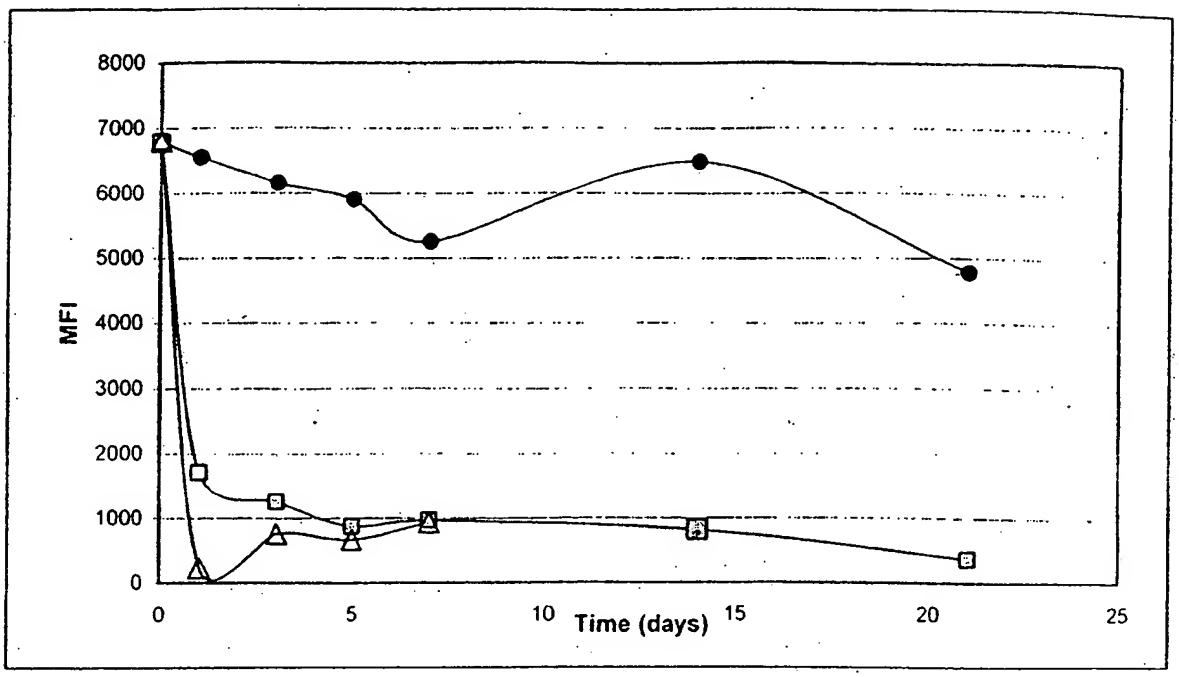

8000
7000
6000
5000
4000
3000
2000
1000
0
MFI
0
5
10
15
20
25
Time (days)

FIG. 9

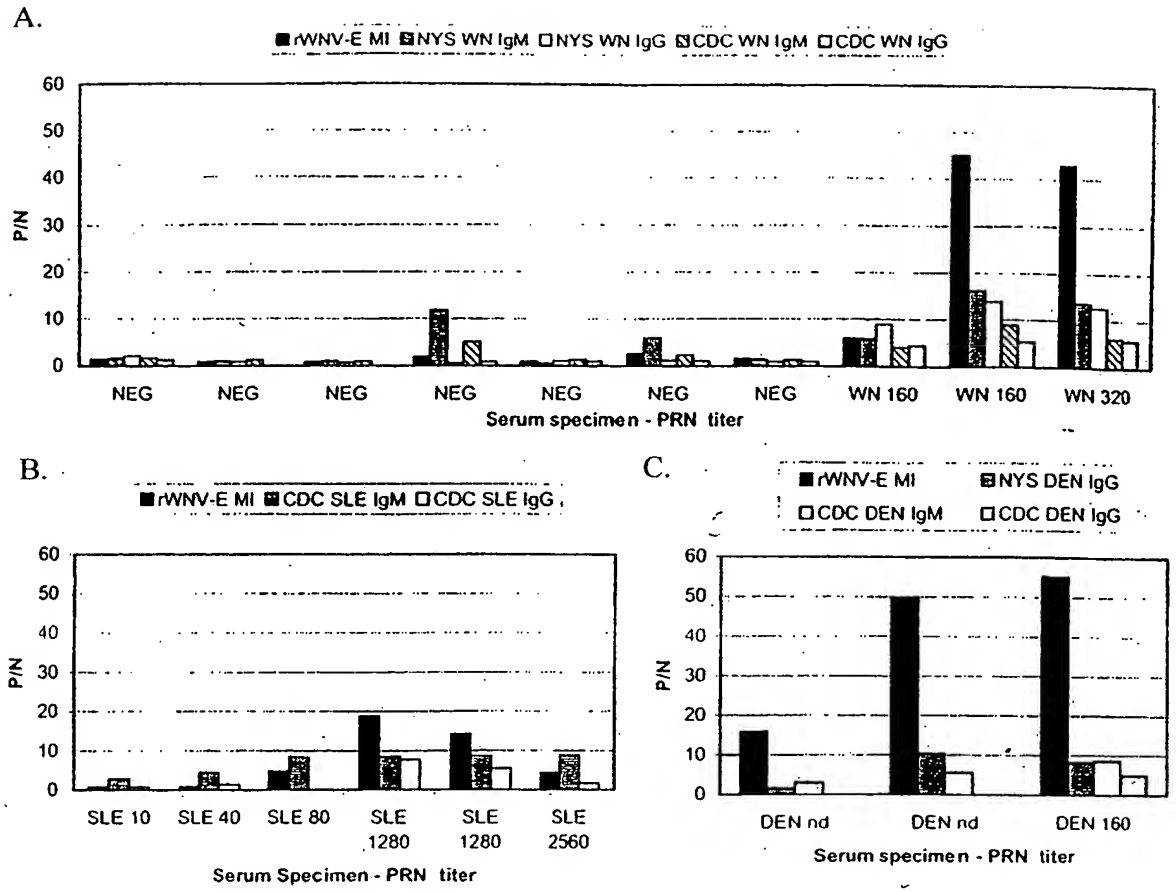
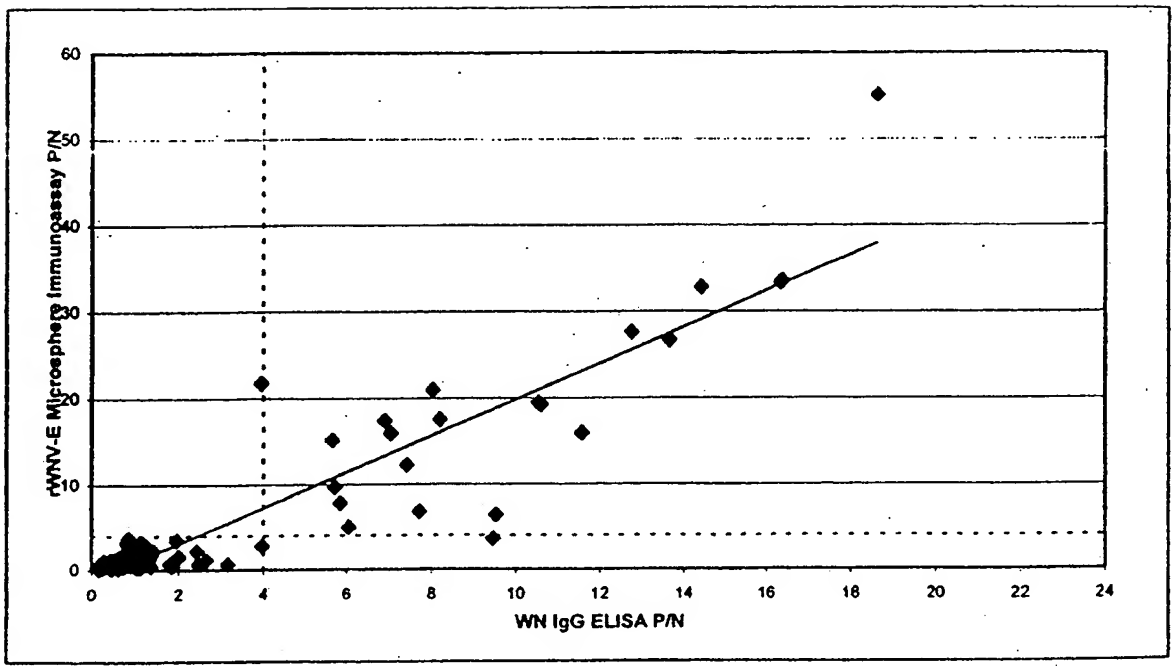

A.
rWNV-E MI
NYS WN IgM
NYS WN IgG
CDC WN IgM
CDC WN IgG
P/N
NEG
NEG
NEG
NEG
NEG
NEG
NEG
WN 160
WN 160
WN 320
Serum specimen - PRN titer
B.
rWNV-E MI
CDC SLE IgM
CDC SLE IgG
P/N
SLE 10
SLE 40
SLE 80
SLE 1280
SLE 1280
SLE 2560
Serum Specimen - PRN titer
C.
rWNV-E MI
NYS DEN IgG
CDC DEN IgM
CDC DEN IgG
P/N
DEN nd
DEN nd
DEN 160
Serum specimen - PRN titer

FIG. 10

A.


rWNV-E Microsphere Immunoassay P/N
WN IgG ELISA P/N
0
10
20
30
40
50
60
0
2
4
6
8
10
12
14
16
18
20
22
24

B.

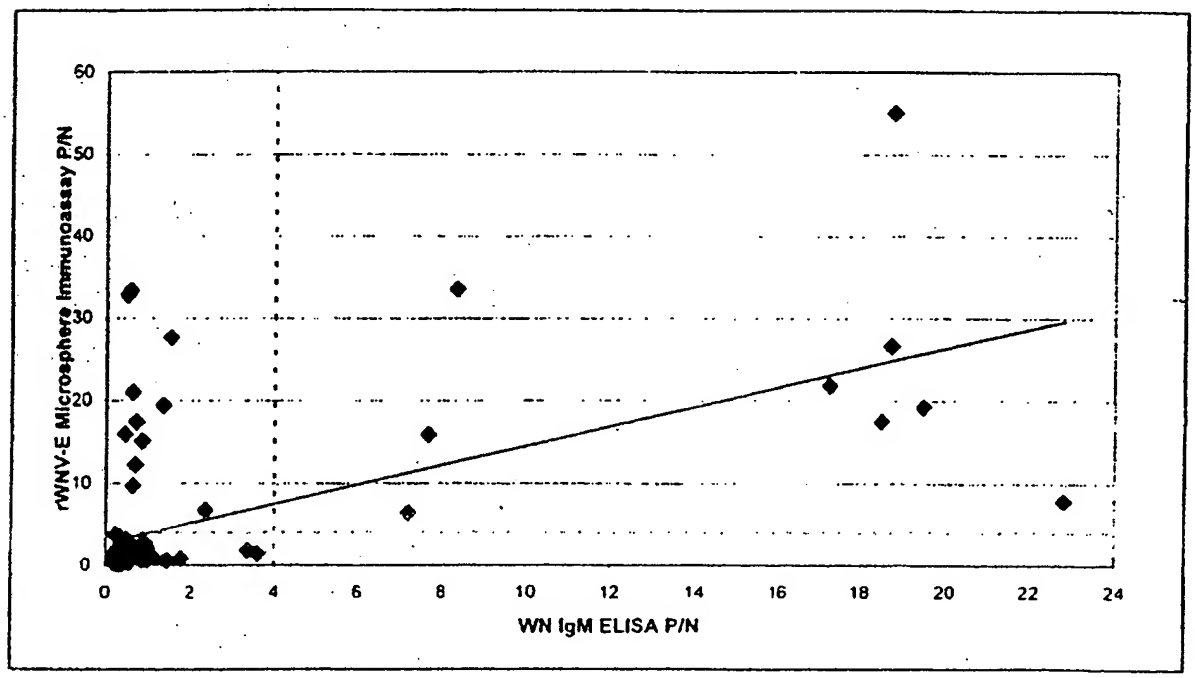
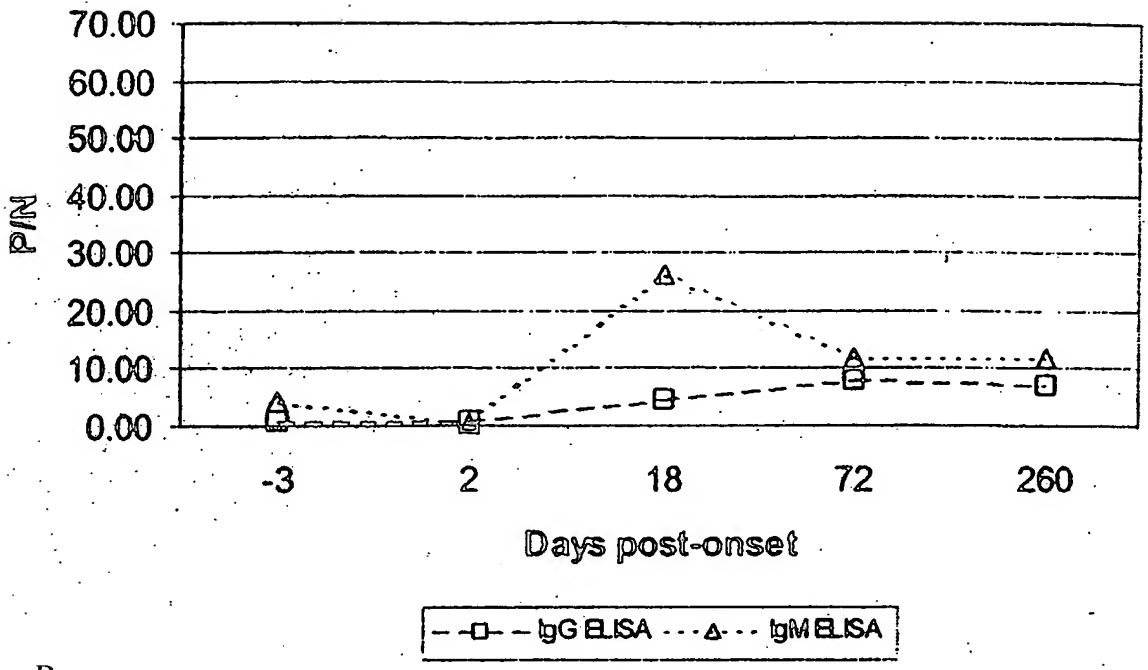

rWNV-E Microsphere Immunoassay P/N
WN IgM ELISA P/N
0
10
20
30
40
50
60
0
2
4
6
8
10
12
14
16
18
20
22
24

FIG. 11

A.


70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
P/N
-3
2
18
72
260
Days post-onset
IgG ELISA
IgM ELISA

B.

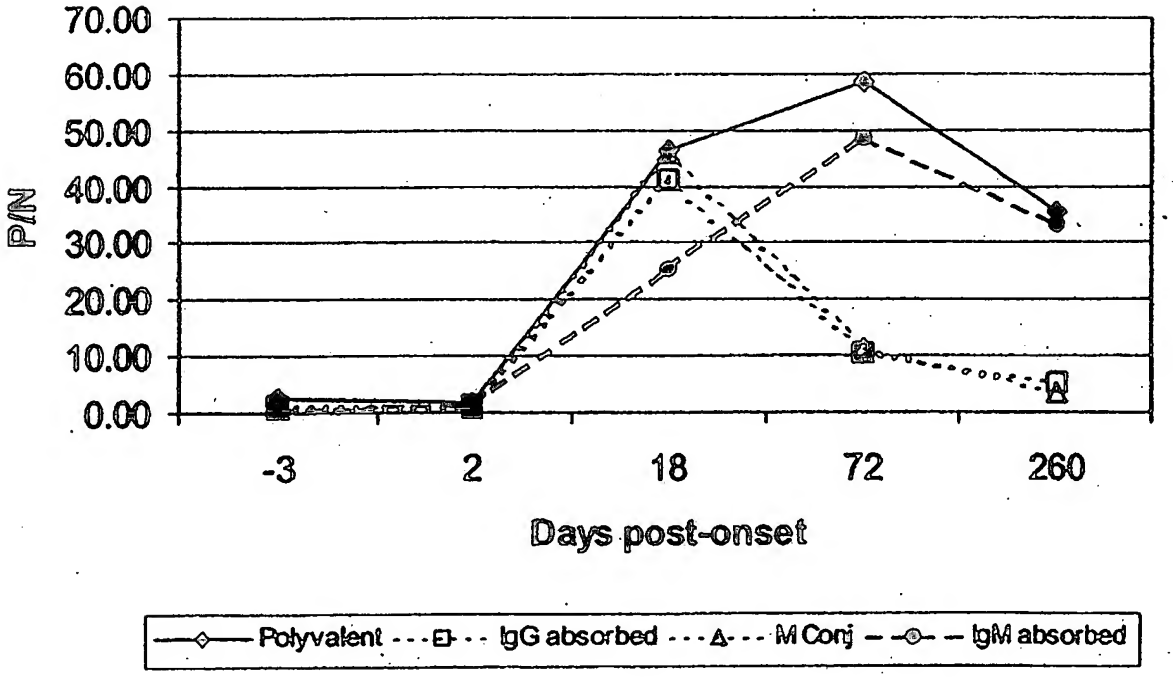
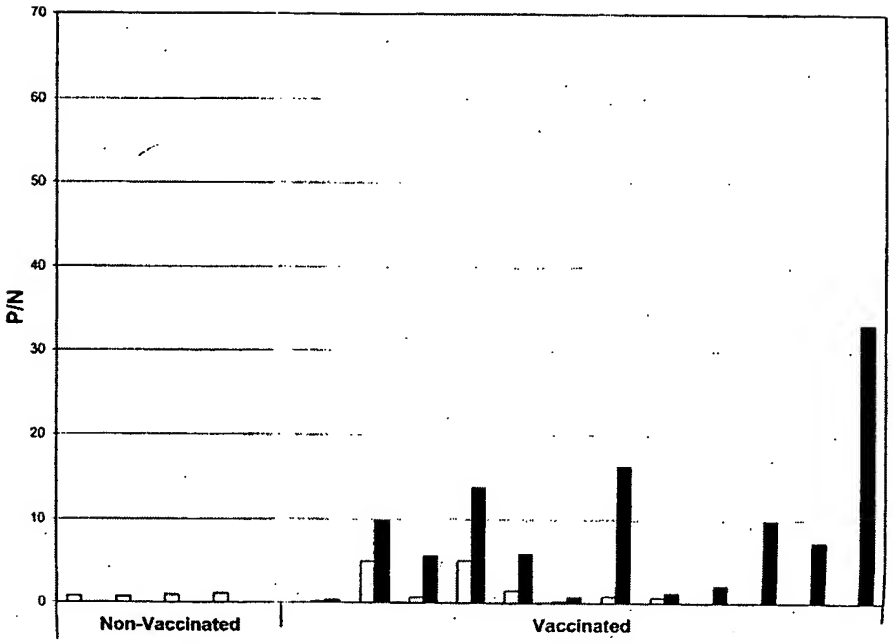

70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
P/N
-3
2
18
72
260
Days post-onset
Polyvalent
IgG absorbed
M Conj
IgM absorbed

FIG. 12

A


70
60
50
40
30
20
10
0
P/N
Non-Vaccinated
Vaccinated

B

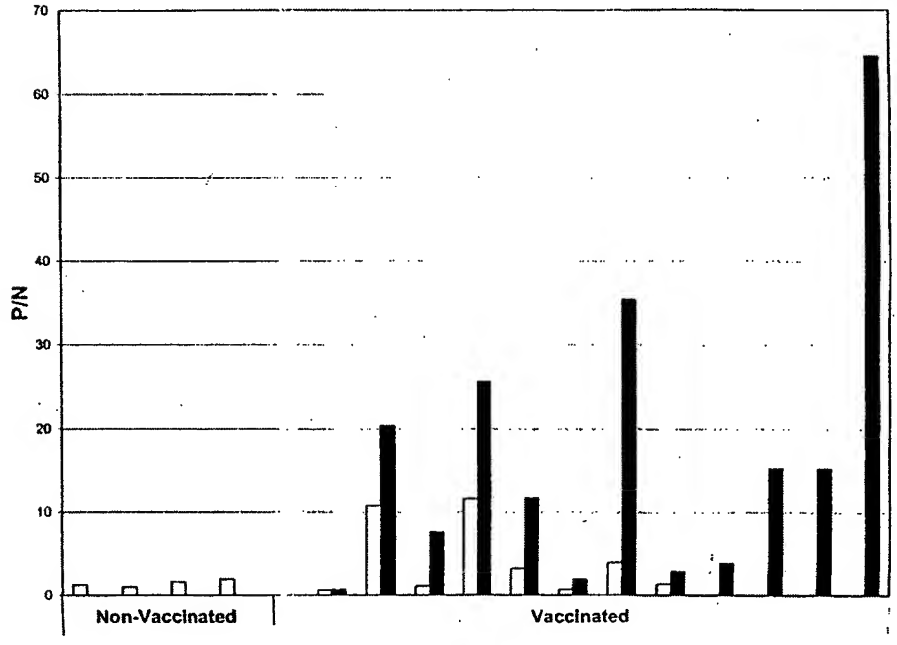

70
60
50
40
30
20
10
0
P/N
Non-Vaccinated
Vaccinated

FIG. 13

A.

Specificity control groups tested by polyvalent rE-MI assay

Specimen Type	Poly Mean P/N	SD	P/N X + 350	No Tested	No P/N > 4
Herpes Simplex	1.77	1.00	4.78	5	0
Epstein Barr	1.44	0.52	3.01	5	0
Syphilis	21.22	15.92	68.97	10	8
Cytonegative	3.58	2.80	11.99	5	2
Human Immuno Deficiency	3.36	5.83	20.84	10	1
Lyme disease	1.77	0.56	3.44	10	0
Ehrlichios Granulocytic	1.72	1.05	4.86	10	2
Antinuclear Antibody	0.86	0.41	2.08	10	0
Rheumatoid Factor	0.62	0.34	1.65	5	0
Purchased Normal sera	2.53			20	3
Syph (TP + RPR -)	5.62	10.69	37.69	10	2

B.

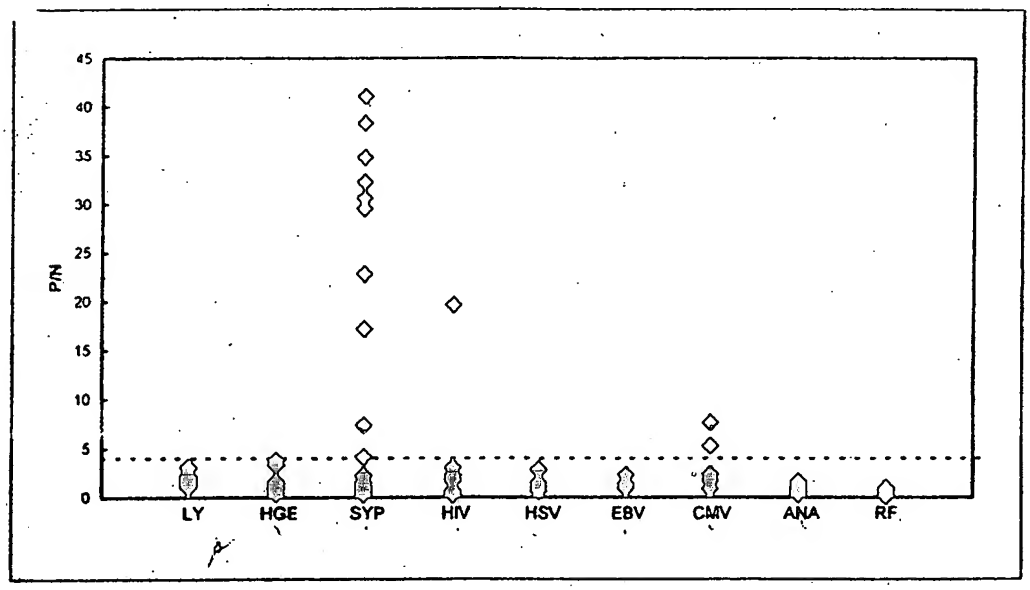


FIG. 14

Polyvalent and IgM rE-MI Results from Spinal Fluids of Patients with Encephalitis due to Flavivirus Infection.

Diagnosis	Polyvalent MFI	IgM MFI	Polyvalent P/N	IgM P/N	MACELISA P/N
1 DEN UT[1]	1142	913	16.6	13.2	NA
2 DEN UT	4066	3150	58.9	45.7	NA
3 FLAVI UT	4421	3287	64.1	47.7	NA
4 FLAVI UT	589	217	8.57	3.1	31.9
5 FLAVI UT	9244	9040	134.0	131	7.5
6 WN UT	1502	QNS[3]	21.8	NA[4]	NA
7 WN C or R[2]	604	QNS	8.8	NA	NA
8 WN C of R	4496	4879	65.2	70.1	NA
9 WN UT	390	39	5.6	.6	9.4
10 WN C of R	1240	1488	18.0	21.6	36.3
11 WN UT	196	217	2.8	3.1	NA

[1] UT Undetermined time
[2] C or R Current or Recent
[3] QNS Quantity not sufficient for testing
[4] NA Not Available

FIG. 15

Polyvalent and IgM rE-MI on Paired Sera and Spinal Fluids Collected on the Same Day

	IgG ELISA P/N	MAC ELISA P/N	Sera MFI	G+A+M Sera P/N	CSF MFI 1:2 in PBS	G+A+M CSF P/N	CSF MFI 1:2 in GullSORB[1]	CSF IgM P/N
Px 1 serum	3.797 R[2]	0.448 NR[3]	8652	70.92				
Px 1 csf		0.171 NR			908.5	41.30	931.5	39.64
Px2 serum	2.476 I[4]	13.241 R	4662.5	38.22				
Px 2 csf		9.391 R			405.5	18.43	QNS	QNS
Px 3 serum	5.446 R	0.774 NR	7193	58.96				
Px 3 csf		1.480 NR			15746	715.73	7308	310.98
Px 4 serum	1.810 NR	26.439 R	2257.5	18.50				
Px 4 csf		28.697 R			1632.5	74.20	1050	44.68
Px 5 serum	4.682 R	1.173 NR	9012	73.87				
Px 5 csf		0.316 NR			3838.5	174.48	3782.5	160.96
Px 6 serum	7.331 R	0.642 NR	9979	81.80				
Px 6 csf		0.409 NR			1629	74.05	633.5	26.96
Px 7 serum	5.668 R	0.8484 NR	6337	51.94				
Px 7 csf		0.213 NR			2777.5	126.25	2113.5	89.94
Pos. serum Control			7037	57.68				
Neg. Serum Control			122					
Pos. CSF Control					1191	54.13	1889	80.38
Neg. CSF Control					22		23.5	

[1] GullSORB (goat anti-human IgG)
[2] R Reactive
[3] NR Non Reactive
[4] I Indeterminate

FIG. 16

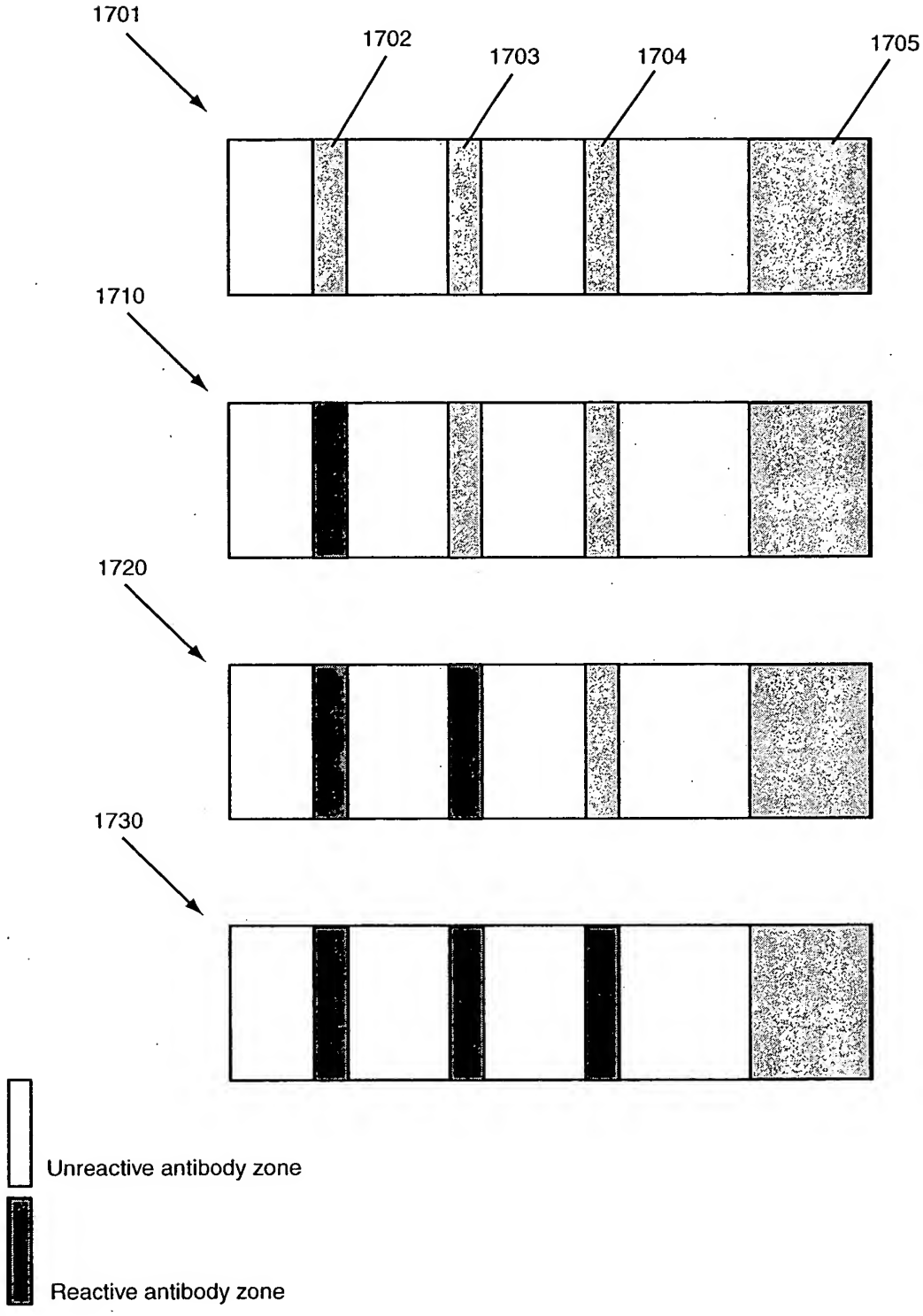

1701
1702
1703
1704
1705
1710
1720
1730
Unreactive antibody zone
Reactive antibody zone

FIG. 17

Mouse sera study by MIA using E antigen, NS3 antigen, NS5 antigen with goat anti-mouse polyvalent conjugate

ID #	E antigen MFI	NS-3 antigen MFI	NS-5 antigen MFI
1	56.0	78.0	469.0
2	92.0	135.0	532.0
3	133.0	165.5	429.0
4	93.0	47.0	539.0
5	96.0	211.0	522.0
6	58.0	70.5	247.5
7	74.0	43.5	295.0
8	79.0	100.0	448.0
9	57.5	112.5	465.0
10	74.0	88.0	518.0
11	160.5	182.0	536.5
12	124.0	172.0	329.0
13	96.5	338.0	555.0
14	85.0	52.0	396.0
15	104.5	120.0	686.0
16	70.5	93.5	376.0
17	120.0	160.0	607.0
18	234.5	150.5	682.5
19	152.5	208.0	738.5
20	400.5	212.0	751.5
21	328.0	338.0	976.0
22	409.0	297.0	966.0
23	493.5	115.0	836.0
24	553.0	158.0	913.0
25	920.5	110.0	699.0
26	574.0	202.0	830.5
27	296.0	171.0	671.0
28	1332.5	209.5	952.0
29	2131.0	110.0	767.0
30	1348.5	54.0	1179.0
31	1288.0	83.0	1694.0
32	1739.0	96.5	1696.0
33	72.5	120.0	572.0
34	91.5	189.5	536.0
35	74.0	128.5	832.0
36	9541.0	241.5	22004.0
37	9368.0	855.0	8992.0
38	7283.0	240.5	23180.0
39	9929.5	364.5	23805.0
40	4615.5	217.0	12511.0
41	5827.0	285.0	15773.0
43	2501.5	711.0	17486.0
44	2177.5	579.0	8985.0
45	13731.5	305.0	22491.0
46	5674.0	232.5	22123.0
47	13299.5	668.5	23032.5
48	9109.5	289.5	20644.5
49	5647.0	190.0	11376.0
50	7356.5	246.0	21734.0
51	13548.0	1400.0	23084.0
53	9808.5	206.0	10484.0
54	7226.0	271.0	15077.0
55	81.5	140.0	552.0
56	88.5	168.5	746.0
57	65.0	135.0	874.0
58	6642.5	239.5	1652.0
59	77.5	156.0	960.0
60	81.0	117.0	590.5
61	88.5	125.0	600.5
62	80.5	122.0	765.5
63	7127.5	93.5	4236.0
64	79.0	137.0	807.5

FIG. 18

NS-5 bead 52 vs 23 Positive West Nile Virus Patient Sera

Assay ID	MIA Poly MFI NS-5 bead 32
1	19152.5
2	11141.5
3	3559.5
4	18598.5
5	11156.5
6	16613.5
7	13215
8	18378.5
9	13870
10	18454.5
11	18690
12	16793
13	13798.5
14	9524
15	4131.5
16	17687
17	3417
18	5561.5
19	16529
20	15778
21	10346.5
22	11725.5
23	17745
Interassay control rWNV-E bead 52 WN Pos	20046
WN Neg	2139.5

MIA Poly MFI NS-3 bead 32	MIA Poly MFI E prot bead 73	P/N	MIA IgM MFI E prot bead 73	P/N	ELISA WN IgG	P/N	ELISA WN IgM	P/N	IFA Other
1114.5	5526	23.82	46.0	1.70	P	22.088	P	16.547	ND
2075.5	7334	31.61	58.5	2.17	P	22.901	P	9.736	P (SLE)
595.5	7906	34.08	79.5	2.94	P	19.376	P	16.112	P (SLE)
785.50	3383.5	14.58	28.0	1.04	P	17.039	P	19.524	ND
1373.00	1438	6.09	1301.5	9.36	P	5.189	P	14.859	ND
1472	4015.5	17.01	323.0	2.32	P	12.94	P	10.581	P (SLE/LAC)
1528.5	3528	14.95	171.0	0.74	P	10.096	P	15.42	ND
4638.5	9605.5	32.56	629.5	2.73	P	6.824	P	11.027	P (SLE)
1129	20304	68.83	218.0	0.94	P	22.835	P	13.459	ND
4936	10829.5	36.71	25.0	0.18	P	18.756	P	14.485	P (SLE)
4162.5	10311	34.95	1055.0	7.59	P	19.535	P	10.537	
4737	10877.5	36.87	2795.0	20.11	P	19.871	P	9.841	
1396.5	10396	35.24	3964.5	28.52	P	22.472	P	10.331	
768	10845	36.76	QNS	QNS	P	21.619	P	10.594	
1100.5	7892.5	26.75	2943.5	21.18	P	8.462	P	15.004	
4855	8475.5	28.73	1445.5	10.40	P	17.764	P	14.308	
887	4901.5	16.93	313.5	2.26	P	9.694	P	8.676	
884	3685	25.15	pending		P	4.81	P	8.587	
3372.5	9713	66.30	pending		P	14.904	P	8.521	
586.5	3741	25.54	pending		P	5.418	P	20.56	
698.5	5217	4.3	pending		P	5.379	P	22.062	
1015.5	13920	11.4	pending		P	9.565	P	25.863	
1873	6897	5.7	pending		P	6.307	P	16.397	

FIG. 19

Paired Dengue Sera Survey

NY Id #	NS-5 MIA MFI	NS-3 MIA P/N	E-Prot 73 MIA MFI	E-Prot MIA P/N
1	1224.5	566.5	279.5	1.03
2	1368	552	2015.5	7.44
3	2324.5	542	1439.5	5.31
4	2613.5	482.5	2950.5	10.89
5	5677	308.5	6586.5	24.30
6	2471.5	324.5	4893.5	18.06
7	1347.5	400	179.5	0.66
8	5749.5	366	1553.5	5.73
9	673.5	490.5	234.5	0.87
10	714.5	452	1496.5	5.52
11	809.5	273.5	112.5	0.42
12	952.5	341.5	1081	3.99
13	2432	323	298	1.10
14	4935	147	2860	10.55
15	720	249	874.5	3.23
16	829	290.5	558	2.06
17	863.5	373	3459	12.76
18	1863.5	462.5	4825.5	17.81
19	1831.5	370.5	1365.5	5.04
20	1754.5	301	6685.5	24.67
21	4657.5	505.5	7473.5	27.58
22	1722.5	323.5	5013	18.50
23	841	599.5	5343.5	19.72
24	794	629.5	6104.5	22.53
25	3833	429.5	824.5	3.04
26	2760.5	360.5	1549	5.72
27	677.5	370.5	5577.5	20.58
28	756.5	532	4720	17.42
29	1548	341.5	4806.5	17.74
30	1586.5	208	8625.5	31.83
31	945	500.5	6159	22.73
32	1127.5	665.5	6416.5	23.68
33	1426.5	452.5	255	0.94
34	1554	504	3107.5	11.47

Controls	
E-Prot	1/23/2003
WN (+)	7013.5
P/N =	25.88
WN (-)	271.0
NS-5	
WN (+)	15656.0
WN (-)	1436.5
NS-3	
WN (+)	493.0
WN (-)	

FIG. 20

NS5 Specificity Study 2/12/03 RHB

Assay Id	NS-5: 52 MFI	E prot MFI	(7/10/02) P/N
Syp1	1736	49.5	0.18
Syp 2	3374.5	70	0.26
Syp 3	2111.5	10259.5	37.38
Syp 4	2357	6839	24.91
Syp 5	1031.5	233.5	0.85
Syp 6	3079	7541	27.47
Syp 7	6.5	1052.5	3.83
Syp 8	1584	186	0.68
Syp 9	17	172.5	0.63
Syp 10	3328.5	345	1.26
		(7/10/02)	
Ly 1	2768	342.5	1.44
Ly 2	1932.5	500.5	2.11
Ly 3	3515	321.5	1.35
Ly 4	1997	298.5	1.26
Ly 5	2266	294.5	1.24
Ly 6	1814.5	188	0.79
Ly 7	2615.5	636	2.68
Ly 8	1567	426.5	1.8
Ly 9	2152.5	408	1.72
Ly 10	2492	300.5	1.27
		(7/12/02)	
HIV 1	1291.5	3256.5	19.68
HIV 2	761	41	0.25
HIV 3	1264	100	0.60
HIV 4	3605	276.5	1.67
HIV 5	1047	69	0.42
HIV 6	1105.5	505.5	3.05
HIV 7	299	316	1.91
HIV 8	1911.5	505.5	3.05
HIV 9	1284.5	113	0.68
FP → HIV10	7517	375	2.27
		(7/10/02)	
HGE1	1935	606.5	2.55
HGE2	2565	297	1.25
HGE3	1244.5	262	1.1
HGE4	1045.5	158	0.67
HGE5	3426.5	302	1.27
HGE6	1883.5	73.5	0.31
HGE7	2274	187.5	0.79
HGE8	1370.5	334	1.41
HGE9	1369.5	311.5	1.31
HGE10	3188	696	2.93

Assay Id	NS-5: 52 MFI	E prot MFI	(7/10/02) P/N
ANA 1	1905.5	165.5	0.7
ANA 2	2824.5	341.5	1.44
ANA 3	942.5	252.5	1.06
ANA 4	736	157	0.66
ANA 5	2256.5	279	1.17
ANA 6	1384.5	109	0.46
ANA 7	1201	147	0.62
ANA 8	477	139.5	0.59
ANA 9	1351	66	0.28
ANA 10	3723	97.5	0.41
		(7/10/02)	
RF 1	85	27	0.11
RF 2	404	60	0.25
RF 3	1235.5	165	0.69
RF 4	667.5	109	0.46
RF 5	1377	197	0.83
RF 6	608	196.5	0.83
		(7/17/02)	
HSV 1	1031	238	0.97
HSV 2	1843	156.5	0.64
HSV 3	2792.5	329	1.33
HSV 4	2796.5	584	2.37
HSV 5	1045.5	611.5	2.48
		(7/17/02)	
CMV 1	873	384.5	1.56
CMV 2	3479.5	523	2.12
CMV 3	809	193.5	0.78
CMV 4	7	2222.5	9.02
CMV 5	2896	857.5	3.48
		(7/17/02)	
EBV 1	1737.5	529.5	2.15
EBV 2	1984	357	1.45
EBV 3	1110.5	383	1.55
EBV 4	2451	194	0.79
EBV 5	2727	226	0.92
		(7/12/02)	
Vaccine Recipients: JE 10	2313.5	3383	20.44
JE 11	1306	1264	7.64
JE 12	3260	4250	25.68
JE 13	638	1941	11.73
JE 14	1271	335	2.02
JE 15	3316	5862.5	35.42
JE 17	1145	645	3.9
JE 18	1247	2540.5	15.35
JE 19	1179	2527	15.27
JE 20	656.5	10689	64.59

FIG. 21

West Nile Virus Case Study-MIA vs. Current Diagnostic Testing Methods

			NYS Current Methods				(6/27/02) Microsphere Immunoassay				(2/23/03)
		Days from	IgG ELISA	MAC ELISA		WN	MIA Poly Ig's		MIA IgM		NS-5 52
ID	Coll. Date	Onset	P/N	P/N	SLE IFA G	PRNT	MFI	P/N	MFI	P/N	MFI
1	9-7-01	-4 d	1.033 NR	4.413 IND	<16	N	457.5	2.56	47.5	3.65	2302
2	9-12-01	+1 d	0.934 NR	0.443 NR	>=16		338.5	1.89	27	2.08	2179
3	9-28-01	+17 d	4.848 R	26.307 R	>=256	P	8310	46.29	751	57.77	12097.5
4	11-21-01	+71 d	8.072 R	12.021 R	>=16	P	10558	58.82	204	15.65	13749
5	5-28-02	+259 d	(****Not done-Employee Screen)				6371	35.49	67	5.15	4055 Neg.
6	11-15-02	+431 d	9.69 R	8.676 R	>=16	nd	4902	16.93	313.5	2.26	3510 Neg.
					Positive Sera Control		6532		95		17832
	Patient Onset = 9/11/01			Pos.	Negative Sera Control		179.5	36.39	13	7.30769	1400

Multiplex Data 2/24/03 RHB

Singlet Data Bead 17-E prot 022603 RHB

ID	MFI NS-5 52	MFI E Prot 17	E-Prot P/N	MFI E Prot 17
1	2364.5	505	1.59	391
2	2052	497	1.57	343.5
3	10880	1482.5	4.68	1142.5
4	10508.5	2463	7.77	2110.5
5	3136	1546	4.88	1038.5
6	1331.5	538.5	1.70	440
7	1331.5	1358.5	4.29	914
WN Pos	15341	2524	7.96	
WN Neg	1208	317		

FIG. 22

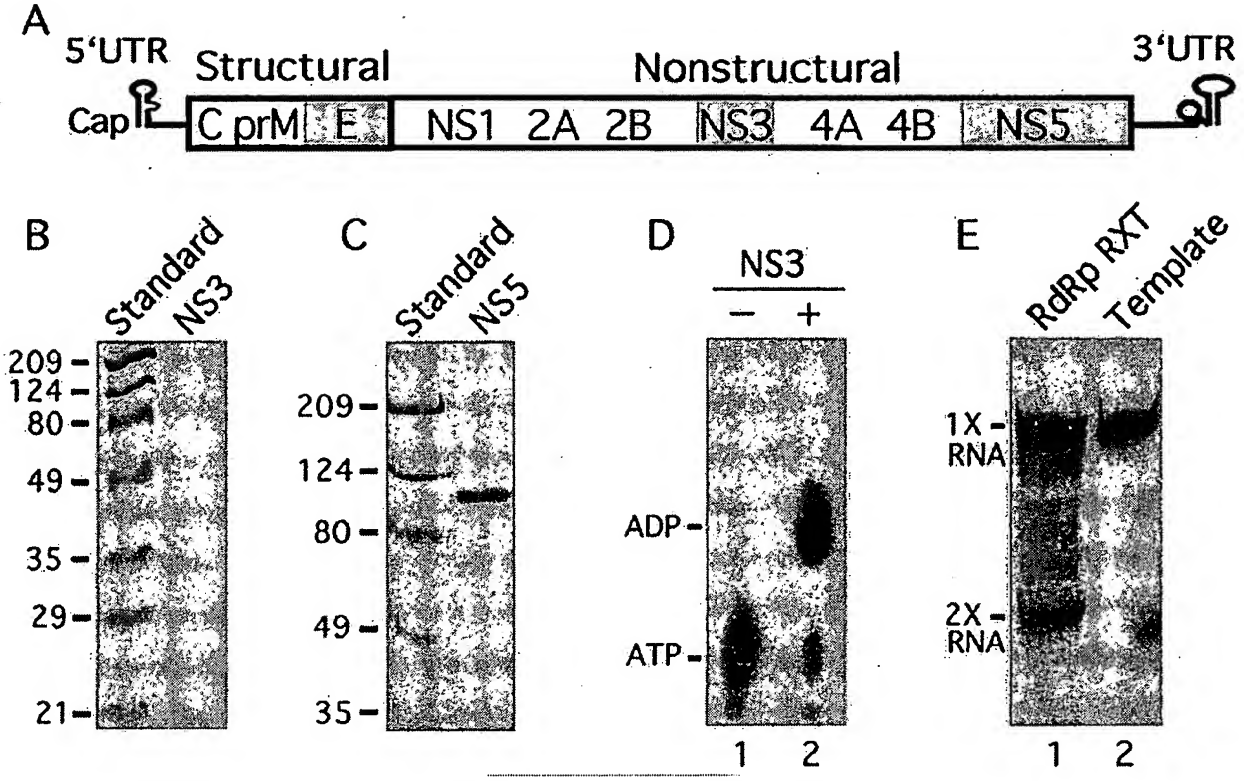

A
5'UTR
Structural
Nonstructural
3'UTR
Cap
C prM E
NS1 2A 2B
NS3
4A 4B
NS5
B
Standard
NS3
209
124
80
49
35
29
21
C
Standard
NS5
209
124
80
49
35
D
NS3
–
+
ADP
ATP
1
2
E
RdRp RXT
Template
1X RNA
2X RNA
1
2

FIG. 23

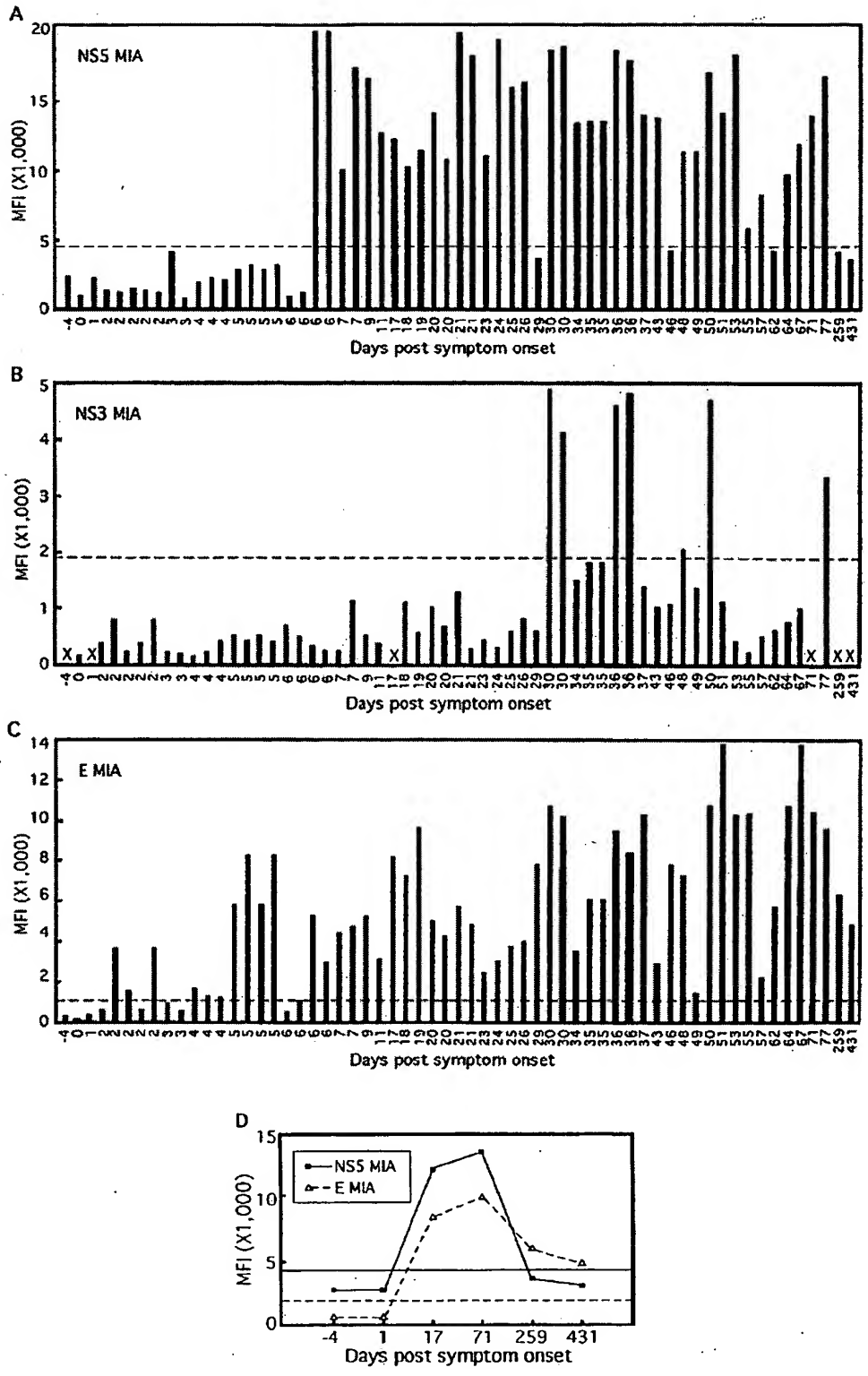

A
NS5 MIA
MFI (X1,000)
Days post symptom onset
B
NS3 MIA
MFI (X1,000)
Days post symptom onset
C
E MIA
MFI (X1,000)
Days post symptom onset
D
NS5 MIA
E MIA
MFI (X1,000)
-4
1
17
71
259
431
Days post symptom onset

FIG. 24

Specificity of the NS5-based MIA tested against various human sera

Specimen type	No. of sera	Mean MFI (range)	SD	No. positive[a]
Syphilis (*T. pallidum* positive)	10	1,862 (7–3,375)	1,241	0
B. burgdorferi infection	10	2,312 (1,567–2,768)	563	0
HIV infection	10	2,009 (299–7,517)	2,127	1
A. phagocytophilum infection	10	2,030 (1,046–3,427)	825	0
Antinuclear antibody positive	10	1,680 (477–3,723)	1,680	0
Rheumatoid factor positive	6	730 (85–1,377)	730	0
Herpes simplex virus positive	5	1,902 (1,031–2,797)	1,902	0
Cytomegalovirus infection	5	1,613 (7–3,480)	1,492	0
Epstein-Barr virus infection	5	2,002 (1,111–2,727)	631	0
JE virus vaccine recipients	10	1,633 (638–3,316)	984	0
YF virus vaccine recipients	19	2,563 (966–5,056)	1,179	1
Normal	20	1,811 (970–3,878)	853	0
Total	120			2

[a] The cutoff for positivity for NS5 is 4,366.

FIG. 25

Cross-reactivity of WNV NS5 and E protein with DENV patient sera

Sample[a]	MFI		Titer	
	NS5[b]	E protein[c]	E protein MIA[d]	HI
1A	1,225	280	<100	10
1B	1,368	2,016	200	160
2A	2,325	1,440	100	20
2B	2,614	2,951	400	80
3A	5,677	6,587	25,600	10,240
3B	2,472	4,894	3,200	320
4A	1,348	180	<100	–
4B	5,750	1,554	200	640
5A	674	235	<100	–
5B	715	1,497	200	40
6A	810	113	<100	–
6B	953	1,081	100	160
7A	2,432	289	<100	–
7B	4,935	2,860	100	80
8A	720	875	<100	20
8B	829	558	<100	80
9A	864	3,459	400	160
9B	1,864	4,826	1600	160
10A	1,832	1,366	100	20
10B	1,755	6,686	6,400	10,240
11A	4,658	7,474	51,200	10,240
11B	1,723	5,013	6,400	1,280
12A	841	5,344	3200	640
12B	794	6,105	12,800	2,560
13A	3,833	825	100	80
13B	2,761	1,549	800	80
14A	678	5,578	6400	2,560
14B	757	4,720	1600	80
15A	1,548	4,807	1600	160
15B	1,587	8,626	51,200	10,240
16A	945	6,159	3,200	640
16B	1,128	6,417	6,400	80
17A	1,427	225	<100	–
17B	1,554	3,108	800	800

[a] Seventeen pairs of acute-phase (A) and convalescent-phase (B) sera from DEN-infected individuals were tested.

[b] The cutoff for positivity for NS5 is 4,366. There were 3 positive samples out of 34 (8.8%).

[c] The cutoff for positivity for E protein is 1,084 (Wong et al., submitted). There were 24 positive samples out of 34 (71%).

[d] E protein MIA titers represent the maximal dilutions of patient sera that were reactive in the E-protein-based MIA above the MFI cutoff of 1,084.

FIG. 26

Cross-reactivity of WNV NS5 and E protein with SLEV patient sera

Sample[a]	MFI		PRNT titer	
	NS5[b]	E protein[c]	SLE virus	WNV
1A	550	953	640	40
1B	892	1,347	1,280	40
2A	1,081	437	320	<10
2B	606	272	320	<10
3A	7,314	492	320	20
3B	5,894	982	640	40
4A	1,157	522	640	10
4B	2,315	828	1,280	40
5A	643	1,582	640	<10
5B	576	1,185	1,280	<10
6A	924	329	10	<10
6B	2,093	1,020	1,280	10
7A	858	456	20	<10
7B	738	214	320	10
8A	215	59	40	<10
8B	324	323	640	20
9A	834	378	80	<10
9B	631	550	160	10
10A	751	196	10	<10
10B	1,272	284	40	<10
11A	778	688	160	10
11B	691	715	320	20
12A	733	864	640	40
12B	1,148	1,388	640	<10
13A	734	966	320	<10
13B	1,731	1,645	320	10
14A	931	409	160	10
14B	802	415	160	<10
15A	1,241	522	40	<10
15B	586	678	320	10
16A	980	3,057	5,120	640
16B	1,420	2,740	2,560	640
17A	1,328	1,490	5,120	1,280
17B	1,912	2,845	1,280	2,560
18A	175	1,679	40	<10
18B	188	1,476	80	<10
19A	398	489	40	<10
19B	628	687	160	<10
20A	1,281	591	640	10
20B	2,296	637	1,280	<10

[a] Twenty pairs of acute-phase (A) and convalescent-phase (B) sera from SLE-infected individuals were tested.

[b] The cutoff for positivity for NS5 is 4,366. There were 2 positive samples out of 40 (5%).

[c] The cutoff for positivity for E protein is 1,084 (Wong et al., submitted). There were 11 positive samples out of 40 (28%).

FIG. 27

Wild Bird MIA- Sera samples

Assay ID	*Poly conjugate* NS 5 MFI	E MFI	*Prot A treated* NS 5 MFI	E MFI
1	491	594.5	192	367.5
2	237.5	149.5	131	100
7	159	148	65.5	88.5
8	174.5	279	122.5	261.5
10	92	538	48	298
14	98	120.5	64.5	73
18	441.5	699	321.5	498
19	1294	234.5	634.5	89.5
22	74.5	55	43	40
25	122	83.5	44	44
30	38.5	35	26	35.5
36	57.5	31	34	28
50	290	234	131	167
80	98.5	135	69	80
115	65	88	41	53.5
Crow 1	2119.5	3558.5	1160.5	2338.5
Crow 2	1925.5	1070	1259	1228.5
Ibis	196	216	169.5	763.5
Heron	421.5	789.5	659	790.5
Argus	169	2169	91	2367.5
Cormorant	6320.5	1280	4642.5	1078.5
Pelican	547	609	362.5	255.5
Goose	754	7246	374.5	5129
Swan	1643	1238.5	6000	2074
Owl	2884	1513	1903	853
Ostrich	482.5	472	425.5	801
Crane	1506.5	1050.5	450	560.5

FIG. 28

Yellow Fever sera from CDC tested against E and NS5 antigens
(polyvalent and IgM)

ID #	E poly MFI	E IgM MFI	NS-5 poly MFI	NS-5 IgM MFI
1	*695.5	326.0	2254.0	1215.0
2	*1852.0	910.0	2766.5	1427.0
3	*1101.0	455.0	2147.5	893.0
4	204.0	111.0	965.5	519.0
5	*745.5	292.5	1124.0	561.0
6	334.5	203.0	1501.0	733.0
7	*886.0	388.5	4313.5	1958.0
8	237.0	155.0	1793.0	1031.5
9	*3157.0	2001.5	4147.0	4971.5
10	388.5	351.5	1369.5	914.0
11	256.5	279.5	2528.5	1685.5
12	194.0	238.5	1906.5	1288.5
13	*3927.0	2061.0	2726.5	1893.0
14	*1350.0	866.5	1355.5	701.5
15	347.5	380.0	4075.0	2464.5
16	568.0	510.5	2279.0	1206.0
17	628.0	407.0	3410.5	1573.5
18	*713.5	538.5	*5055.5	3437.5
19	*891.0	401.0	2968.5	1450.5
WN +	2602.0	1537.0	15419.5	9033.5
WN -	339.0	177.5	1780.5	474.5
Cutoff	**676.25**	x	**4368.85**	x

*MFI values are above the established cutoffs.
Cutoff values for IgM have yet to be established.

FIG. 29

West Nile Virus MIA of Horse Sera (Blinded)
(Poly Ig's)

Sample #	E (17)MFI	NS 5 (52)MFI	NS 3 MFI	Category	IgM O.D.	P/N	MAC	PRNT	
1	932	4587	1522	IgM Positive Non-vac	0.503	4.191	Positive	Positive	Clinically Ill
2	895	169	81	IgM Positive Non-vac	1.1685	6.023	Positive	Positive	Clinically Ill
3	1945.5	3681.5	573	IgM Positive Non-vac	0.475	3.39	Positive	Positive	Clinically Ill
4	274	147	85	IgM Positive Non-vac	1.4545	16.347	Positive	Positive	Clinically Ill
5	1806	259	290	IgM Positive Non-vac	0.8475	10.463	Positive	Positive	Clinically Ill
6	296	543.5	55	IgM Positive Non-vac	0.7245	7.546875	Positive	Positive	Clinically Ill
Mean	*1024.8*	*1564.5*	*434.3*						
SD	*718.1*	*2016.0*	*568.1*						
Mean +SD	*1742.8*	*3580.5*	*1002.5*						
7	70	82.5	29	Pre-bleeds from WNV Neg county	0.234	2.445	Negative		Healthy Non-exposed
8	63	78	36.5	Pre-bleeds from WNV Neg county	0.020	0.975	Negative		Healthy Non-exposed
9	72	71	31.5	Pre-bleeds from WNV Neg county	0.002	0.114	Negative		Healthy Non-exposed
10	64	247.5	43	Pre-bleeds from WNV Neg county	0.092	1.219	Negative		Healthy Non-exposed
11	128	203	201	Pre-bleeds from WNV Neg county	0.008	2.286	Negative		Healthy Non-exposed
12	64	63.5	43	Pre-bleeds from WNV Neg county	0.123	2.526	Negative		Healthy Non-exposed
13	92	112.5	256	Pre-bleeds from WNV Neg county	0.094	1.438	Negative		Healthy Non-exposed
14	67	109.5	37	Pre-bleeds from WNV Neg county	0.085	1.142	Negative		Healthy Non-exposed
15	63.5	63	49.5	Pre-bleeds from WNV Neg county	0.055	1.982	Negative		Healthy Non-exposed
16	63.5	125	81	Pre-bleeds from WNV Neg county	0.093	0.939	Negative		Healthy Non-exposed
17	92.5	115	37	Pre-bleeds from WNV Neg county	0.039	0.886	Negative		Healthy Non-exposed
Mean	*76.3*	*115.5*	*76.8*						
SD	*20.3*	*59.3*	*77.3*						
Mean +SD	*96.6*	*174.8*	*154.0*						
18	69.5	244	37	WN IgM Negative Prevaccination	0.240	1.023	Negative		Healthy Non-exposed ath the time of vaccination
19	63	69	89.5	WN IgM Negative Prevaccination	-0.003	0.455	Negative		Healthy Non-exposed ath the time of vaccination
20	3515	183.5	52	WN IgM Postive Prevaccination	1.498	22.358	Positive		Healthy Exposed at the time of vaccination
21	66	239	43	WN IgM Negative Prevaccination	0.036	1.108	Negative		Healthy Non-exposed ath the time of vaccination
22	719.5	683.5	31.5	WN IgM Postive Prevaccination	1.474	133.955	Positive		Healthy Exposed at the time of vaccination
Mean	*253.9*	*283.8*	*50.6*						
SD	*288.1*	*234.3*	*23.0*						
Mean +SD	*542.0*	*518.1*	*73.6*						
23	4393	2123	1079	WN IgM Postive Postvaccination	1.071	2.333	Positive		Healthy Exposed at the time of vaccination
24	2683	1744	2008	WN IgM Postive Postvaccination	1.552	33.376	Positive		Healthy Exposed at the time of vaccination
25	2381.5	2376.5	1297.5	WN IgM Postive Postvaccination	0.721	9.945	Positive		Healthy Exposed at the time of vaccination
26	2509.5	875	2374.5	WN IgM Postive Postvaccination	0.449	3.606	Positive		Healthy Exposed at the time of vaccination
27	5177.5	1146.5	1112	WN IgM Postive Postvaccination	0.449	5.470	Positive		Healthy Exposed at the time of vaccination
Mean	*3428.9*	*1653.0*	*1574.2*						
SD	*1273.4*	*635.3*	*584.0*						
Mean +SD	*4702.3*	*2288.3*	*2158.2*						
28	296	100	41.5	IgM Negative Postvaccination	0.040	0.414	Negative		Healthy Non-exposed
29	104.5	94.5	95	IgM Negative Postvaccination	0.004	0.138	Negative		Healthy Non-exposed
30	1094	41	26.5	IgM Negative Postvaccination	0.116	0.840	Negative		Healthy Non-exposed
31	61	59	28.5	IgM Negative Postvaccination	0.067	0.522	Negative		Healthy Non-exposed
32	120	364.5	79.5	IgM Negative Postvaccination	0.190	0.785	Negative		Healthy Non-exposed
33	60.5	108.5	45.5	IgM Negative Postvaccination	0.007	0.245	Negative		Healthy Non-exposed
34	838.5	84.5	53	IgM Negative Postvaccination	0.050	0.717	Negative		Healthy Non-exposed
35	127	198.5	65	IgM Negative Postvaccination	0.168	0.952	Negative		Healthy Non-exposed
36	127	3504	140	IgM Negative Postvaccination	0.123	0.988	Negative		Healthy Non-exposed
37	83	166	11	IgM Negative Postvaccination	0.075	0.993	Negative		Healthy Non-exposed
Mean	*291.2*	*472.1*	*58.6*						
SD	*366.9*	*1069.4*	*38.2*						
Mean +SD	*658.1*	*1541.4*	*96.7*						

FIG. 30A

Horse West Nile Virus Multiplex

Horse Id	MFI NS3(21)	MFI NS 5(52)	MFI E(75)		Previous assay results MFI NS3	MFI NS 5	MFI E
d0	38	64	49.5		98.5	430	281
d20	51	77	430		169.5	500	303.5
d41	53	66	13827		1217	424.5	273
d49	53	67	17427		1566.5	250.5	296.5
d78	49	70	13347		1040	342	312.5
d0	38	43.5	65		264.5	2082	501.5
d20	45.5	47	168	4-9-03	242	1980.5	520
d41	39	52	14347	*E-19,NS5-52*	1921	2144.5	597
d49	48	47	18004.5	*NS3-32*	2721	2278	629.5
d78	35	44	14353		1897	2265.5	583.5
d0	53	112	58		45.5	832	297.5
d20	69.5	133.5	678.5		114.5	937	343
d41	43.5	96	9680		1232.5	863	335.5
d49	51.5	95	13811		1372	868.5	301.5
d78	48	92	8931.5		692.5	528	190
02-36646	45.5	46.5	408				
02-37562	381	1889.5	3831.5				
02-36729	15	48.5	1978				
1976	38.5	233	47		59	320	62
2761	71	72	70		90	122	95.5
2765	56	67	201	4-	231	122	54
2874	36	71.5	48		62	109	5
2384	223	126	147		171.5	176	280
2900	34	54	52		66.5	89.5	55
2920	41	62	51.5		72	109	70
1	182.5	3043	2071				
2	33.5	68	1201				
3	94	2735	2003.5				
4	28.5	47.5	168				
5	77	125.5	2087				
6	27	368	288				
7	28	34.5	34.5				
8	39	41	55				
9	20	32	43				
10	27.5	39	38.5				
11	51	51.5	106				
12	34	41.5	40.5				
13	66	45	48.5				
14	28.5	43.5	42				
15	19.5	26	35				
16	30.5	31	34				
17	20.5	53	40				
18	17	97	36				
19	51	29	47				
20	34	66	306				
21	39	62.5	41				
22	23	289.5	1003				
23	347.5	2598	4507				
24	173.5	1133	3219				
25	165	2093	2877.5				
26	370	463	2554				
27	275	625	6426				
28	36.5	74	388				
29	45	55.5	115.5				
30	26.5	57	1439				
31	31.5	43	43				
32	73	139	80				
33	40.5	50	44				
34	25	29.5	737				
35	36	52	136				
36	99.5	1688.5	94				
37	31	60.5	70				
	20	34	50				
	23	492.5	437.5				
	91.5	73	1230				
	30	60	164.5				

FIG. 30B

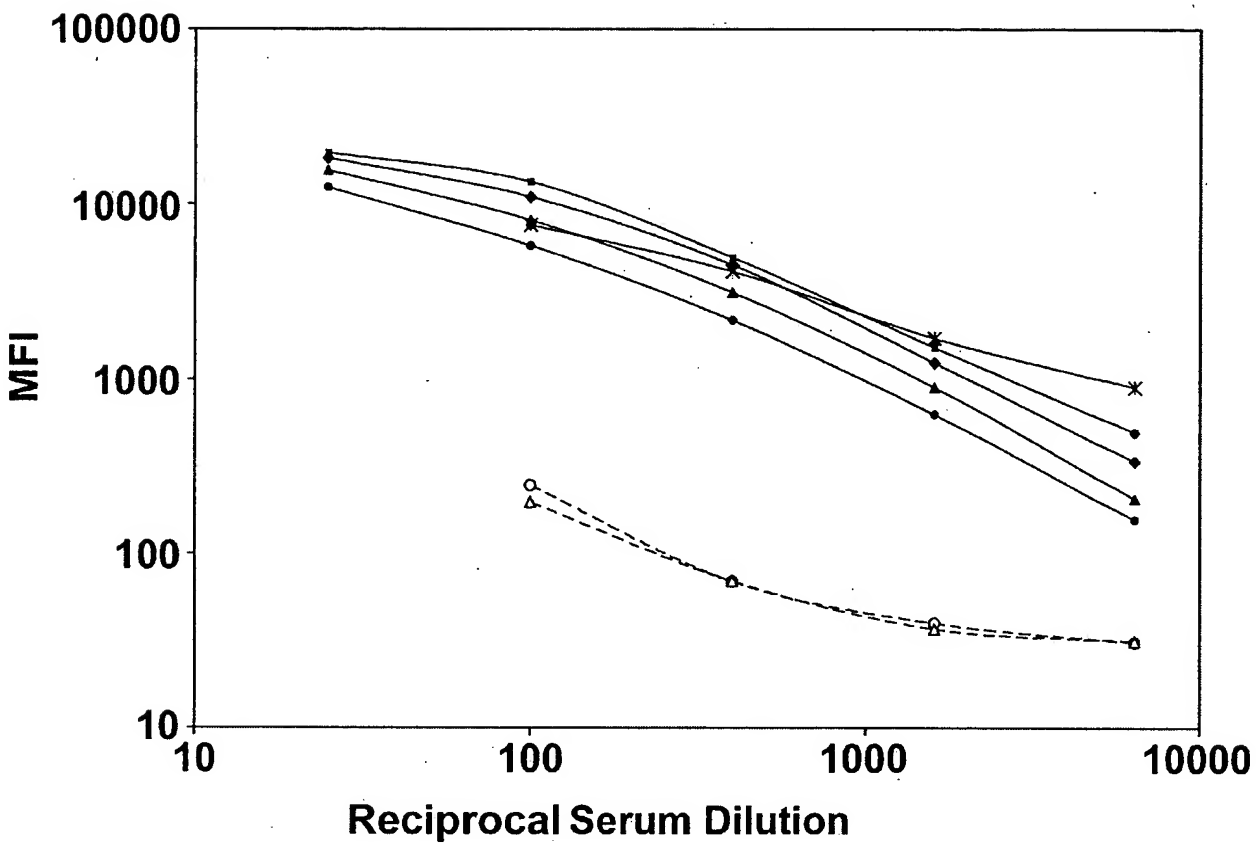

100000
10000
1000
100
10
MFI
10
100
1000
10000
Reciprocal Serum Dilution

FIG. 31

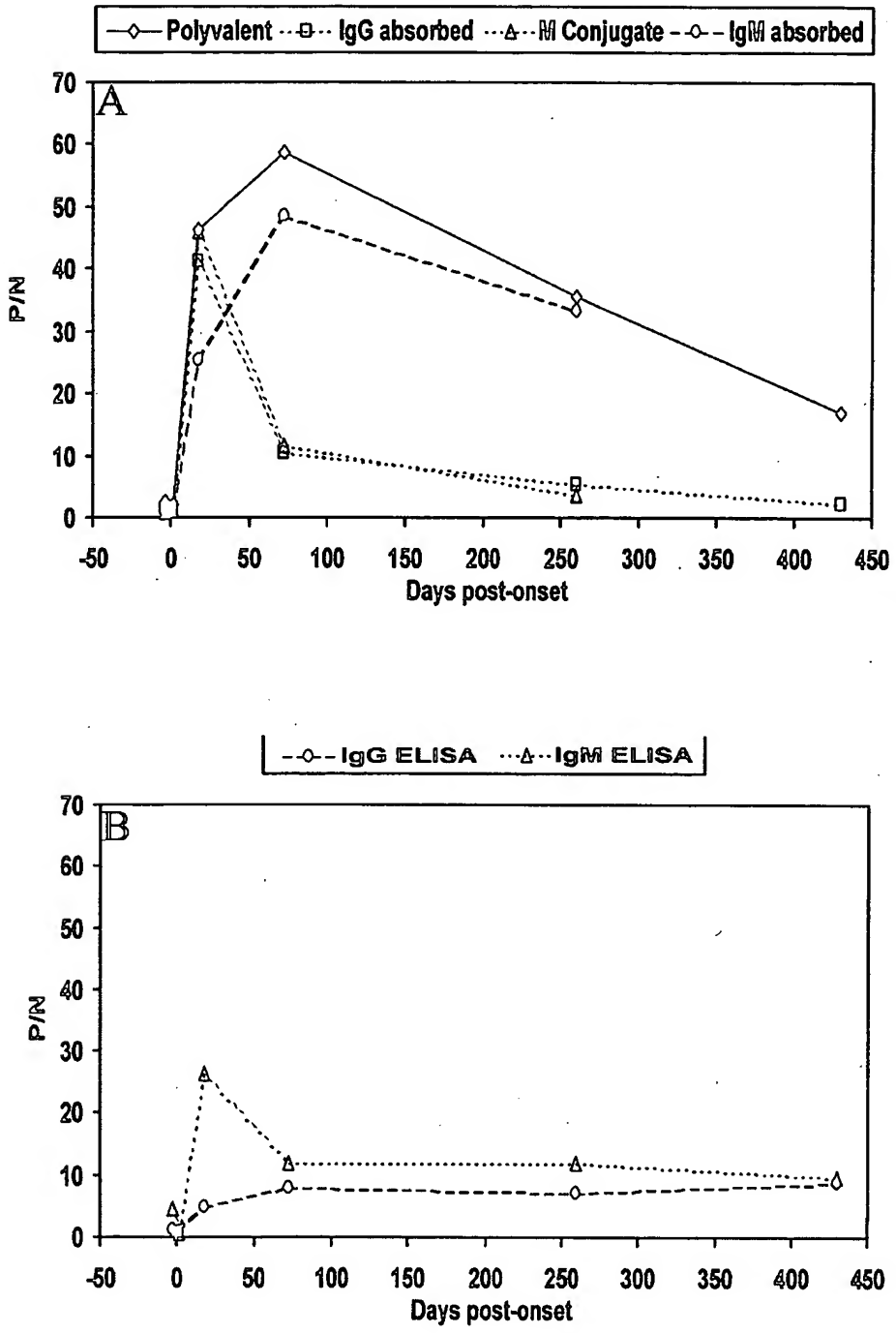

Polyvalent
IgG absorbed
M Conjugate
IgM absorbed
A
P/N
Days post-onset
IgG ELISA
IgM ELISA
B
P/N
Days post-onset

FIG. 32

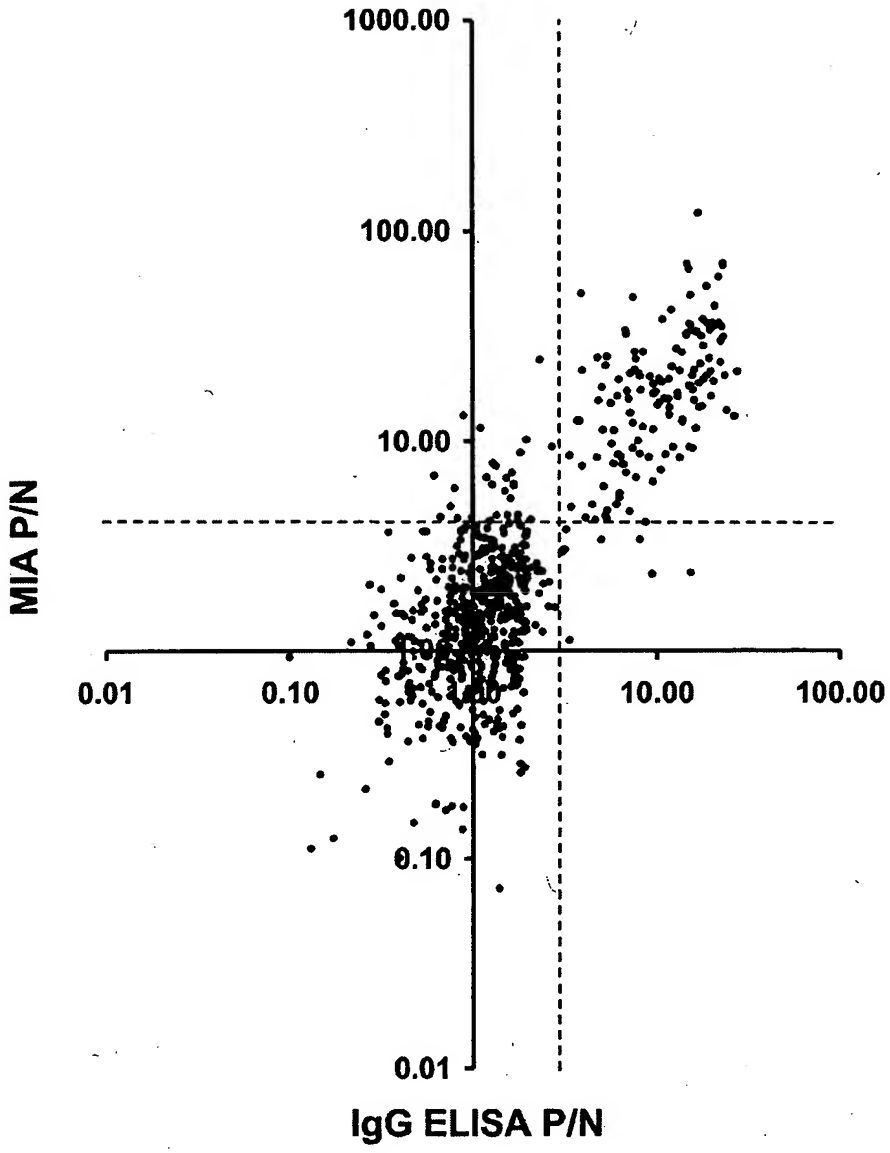

1000.00
100.00
10.00
0.10
0.01
0.01
0.10
10.00
100.00
MIA P/N
IgG ELISA P/N

FIG. 33

Detection of flavivirus antibodies by the WNV-E MIA and by ELISA in a blinded serum panel

Serum no.	Etiologic virus PRN titer	rWNV-E MIA P/N Polyvalent	WN ELISA IgG NYS[3] P/N	WN ELISA IgG CDC P/N	WN ELISA IgM NYS P/N	WN ELISA IgM CDC P/N	DEN ELISA IgG NYS P/N	SLE ELISA IgG CDC P/N	SLE ELISA IgM CDC P/N
1	NEG[1]	1.31	2.01	1.20	1.51	1.59	0.12	nd	nd
2	NEG	0.79	0.78	nd	0.93	1.17	0.08	nd	nd
3	NEG	0.81	0.62	nd	0.96	0.95	0.10	nd	nd
4	NEG	1.90	0.48	0.82	11.79	5.04	0.16	nd	nd
5	NEG	0.86	0.96	0.89	0.46	1.26	0.14	nd	nd
6	NEG	2.62	1.06	0.97	5.89	2.23	0.31	nd	nd
7	NEG	1.48	0.88	0.90	1.34	1.25	0.30	nd	nd
8	WN 160	5.89	8.96	4.40	5.76	4.02	0.49	nd	nd
9	WN 160	45.15	13.96	5.28	16.25	8.90	2.58	nd	nd
10	WN 320	42.99	12.77	5.80	13.73	6.16	3.04	nd	nd
11	SLE 2560	4.28	2.56	nd	7.57	3.26	0.57	1.68	8.89
12	SLE 40	0.90	1.44	1.05	1.98	1.52	0.10	1.39	4.48
13	SLE 1280	18.88	7.26	7.05	10.06	3.67	1.34	7.69	8.53
14	SLE 1280	14.34	3.17	3.63	14.33	7.00	0.86	5.45	8.69
15	SLE 80	4.80	1.43	1.45	8.44	3.65	0.19	nd	8.43
16	SLE 10	0.80	0.98	0.77	3.52	1.74	0.20	0.80	2.76
17	DEN nd[2]	49.90	20.06	nd	12.90	1.62	10.39	nd	nd
18	DEN nd	15.99	3.22	nd	13.59	1.72	1.59	nd	nd
19	DEN 160	55.23	15.85	nd	3.85	nd	8.28	nd	nd

[1] Specimen was negative to neutralizing flavivirus antibodies

[2] Test was not performed on specimen

[3] Tests were performed at the New York State Department of Health, Wadsworth Center, Albany, New York

FIG. 34

Human specificity control sera tested by p lyvalent rWNV-E MIA.

Specimen Type	*n*	Mean P/N (range)	P/N > 4.0	P/N > 5.0
Herpes simplex virus infection	5	1.77 ± 1.00 (0.64-2.83)	0	0
Epstein Barr virus infection	5	1.44 ± 0.52 (0.92-2.31)	0	0
Syphilis panel 1[a]	10	21.22 ± 15.9 (1.15-41.1)	8 (80%)	7 (70%)
Syphilis panel 2 (TPPA+, RPR-)[b]	10	5.62 ± 10.7 (0.35-32.3)	2 (20%)	2 (20%)
Cytomegalovirus infection	5	3.58 ± 2.80 (0.89-7.64)	2 (40%)	2 (40%)
Human immunodeficiency virus infection	10	3.36 ± 5.83 (0.25-19.7)	1 (10%)	1 (10%)
B. burgdorferi infection	10	1.77 ± 0.56 (1.09-3.08)	0	0
A. phagocytophila infection	10	1.72 ± 1.05 (0.45-3.78)	0	0
Antinuclear Antibody positive	10	0.86 ± 0.41 (0.37-1.63)	0	0
Rheumatoid Factor positive	6	0.62 ± 0.34 (0.17-1.11)	0	0
Normal sera	24	2.34 ± 1.26 (0.96-4.82)	4 (17%)	0
Total:	105		17 (16%)	12 (11%)

[a] Rapid plasma reagin (RPR) positive

[b] *Treponema pallidum* particle agglutination (TPPA) positive, RPR negative

FIG. 35

Detection of anti-flavivirus antibodies in spinal fluid

Specimen no.	MFI of CSF 1:2 in PBS [a] (IgG+IgA+IgM)	MFI of CSF 1:2 in GullSORB [b] (IgM)	Viral etiology by PRN assays	
1	909	932	WN	UT [c]
2	1632	1050	WN	C or R [d]
3	3838	3783	WN	UT
4	1629	634	WN	UT
5	2778	2114	WN	UT
6	15,746	7308	WN	UT
7	4496	4879	WN	C or R
8	1240	1488	WN	C or R
9	390	39	WN	UT
10	196	217	WN	UT
11	1142	913	DEN	UT
12	4066	3150	DEN	UT
13	4421	3287	FLAVI [e]	UT
14	589	217	FLAVI	UT
15	9244	9040	FLAVI	UT

[a] Median fluorescent intensity, 100 beads, with polyvalent conjugate
[b] Median fluorescence intensity, 100 beads, following IgG depletion
[c] UT = undetermined time of infection
[d] C or R = current or recent infection
[e] FLAVI = indeterminate flavivirus

FIG. 36

Nucleotide sequence of GenBank accession No. AF206518 (WVN isolate 2741)

FIG. 37a

```
   1 gctgacaaac ttagtagtgt ttgtgaggat taacaacaat taacacagtg cgagctgttt
  61 cttagcacga agatctcgat gtctaagaaa ccaggagggc ccggcaagag ccgggctgtc
 121 aatatgctaa aacgcggaat gccccgcgtg ttgtccttga ttggactgaa gagggctatg
 181 ttgagcctga tcgacggcaa ggggccaata cgatttgtgt tggctctctt ggcgttcttc
 241 aggttcacag caattgctcc gacccgagca gtgctggatc gatggagagg tgtgaacaaa
 301 caaacagcga tgaaacacct tctgagtttt aagaaggaac tagggacctt gaccagtgct
 361 atcaatcggc ggagctcaaa acaaaagaaa agaggaggaa agaccggaat tgcagtcatg
 421 attggcctga tcgccagcgt aggagcagtt accctctcta acttccaagg gaaggtgatg
 481 atgacggtaa atgctactga cgtcacagat gtcatcacga ttccaacagc tgctggaaag
 541 aacctatgca ttgtcagagc aatggatgtg ggatacatgt gcgatgatac tatcacttat
 601 gaatgcccag tgctgtcggc tggtaatgat ccagaagaca tcgactgttg gtgcacaaag
 661 tcagcagttt acgtcaggta tggaagatgc accaagacac gccactcaag acgcagtcgg
 721 aggtcactga cagtgcagac acacggagaa agcactctag cgaacaagaa gggggcttgg
 781 atggacagca ccaaggccac aaggtacttg gtaaaaacag aatcatggat cttgaggaac
 841 cctggatatg ccctggtggc agccgtcatt ggttggatgc ttgggagcaa caccatgcag
 901 agagttgtgt ttgtcgtgct attgcttttg gtggccccag cttacagctt caactgcctt
 961 ggaatgagca acagagactt cttggaagga gtgtctggag caacatgggt ggatttggtt
1021 ctcgaaggcg acagctgcgt gactatcatg tctaaggaca agcctaccat cgatgtgaag
1081 atgatgaata tggaggcggc caacctggca gaggtccgca gttattgcta tttggctacc
1141 gtcagcgatc tctccaccaa agctgcgtgc ccgaccatgg gagaagctca caatgacaaa
1201 cgtgctgacc cagcttttgt gtgcagacaa ggagtggtgg acaggggctg gggcaacggc
1261 tgcggactat ttggcaaagg aagcattgac acatgcgcca aatttgcctg ctctaccaag
1321 gcaataggaa gaaccatctt gaaagagaat atcaagtacg aagtggccat ttttgtccat
1381 ggaccaacta ctgtggagtc gcacggaaac tactccacac aggttggagc cactcaggca
1441 gggagattca gcatcactcc tgcagcgcct tcatacacac taaagcttgg agaatatgga
1501 gaggtgacag tggactgtga accacggtca gggattgaca ccaatgcata ctacgtgatg
1561 actgttggaa caaagacgtt cttggtccat cgtgagtggt tcatggacct caacctccct
1621 tggagcagtg ctggaagtac tgtgtggagg aacagagaga cgttaatgga gtttgaggaa
1681 ccacacgcca cgaagcagtc tgtgatagca ttgggctcac aagagggagc tctgcatcaa
1741 gctttggctg gagccattcc tgtggaattt tcaagcaaca ctgtcaagtt gacgtcgggt
1801 catttgaagt gtagagtgaa gatggaaaaa ttgcagttga agggaacaac ctatggcgtc
1861 tgttcaaagg ctttcaagtt tcttgggact cccgcagaca caggtcacgg cactgtggtg
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1981 tcattgaacg acctaacgcc agtgggcaga ttggtcactg tcaacccttt tgtttcaatg
2041 gccacggcca acgctaaggt cctgattgaa ttggaaccac cctttggaga ctcatacata
2101 gtggtgggca gaggagaaca acagatcaat caccattggc acaagtctgg aagcagcatt
2161 ggcaaagcct ttacaaccac cctcaaagga gcgcagagac tagccgctct aggagacaca
2221 gcttgggact ttggatcagt tggaggggtg ttcacctcag ttgggaaggc tgtccatcaa
2281 gtgttcggag gagcattccg ctcactgttc ggaggcatgt cctggataac gcaaggattg
2341 ctgggggctc tcctgttgtg gatgggcatc aatgctcgtg ataggtccat agctctcacg
2401 tttctcgcag ttggaggagt tctgctcttc ctctccgtga acgtgcacgc tgacactggg
2461 tgtgccatag acatcagccg gcaagagctg agatgtggaa gtggagtgtt catacacaat
2521 gatgtggagg cttggatgga ccggtacaag tattaccctg aaacgccaca aggcctagcc
2581 aagatcattc agaaagctca taaggaagga gtgtgcggtc tacgatcagt ttccagactg
2641 gagcatcaaa tgtgggaagc agtgaaggac gagctgaaca ctcttttgaa ggagaatggt
2701 gtggacctta gtgtcgtggt tgagaaacag gagggaatgt acaagtcagc acctaaacgc
2761 ctcaccgcca ccacggaaaa attggaaatt ggctggaagg cctggggaaa gagtatttta
2821 tttgcaccag aactcgccaa caacaccttt gtggttgatg gtccggagac caaggaatgt
2881 ccgactcaga atcgcgcttg gaatagctta gaagtggagg attttggatt tggtctcacc
2941 agcactcgga tgttcctgaa ggtcagagag agcaacacaa ctgaatgtga ctcgaagatc
3001 attggaacgg ctgtcaagaa caacttggcg atccacagtg acctgtccta ttggattgaa
3061 agcaggctca atgatacgtg gaagcttgaa agggcagttc tgggtgaagt caaatcatgt
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Nucleotide sequence of GenBank accession No. AF206518 (WVN isolate 2741)

FIG. 37b

```
3121 acgtggcctg agacgcatac cttgtggggc gatggaatcc ttgagagtga cttgataata
3181 ccagtcacac tggcgggacc acgaagcaat cacaatcgga gacctgggta caagacacaa
3241 aaccagggcc catgggacga aggccgggta gagattgact tcgattactg cccaggaact
3301 acggtcaccc tgagtgagag ctgcggacac cgtggacctg ccactcgcac caccacagag
3361 agcggaaagt tgataacaga ttggtgctgc aggagctgca ccttaccacc actgcgctac
3421 caaactgaca gcggctgttg gtatggtatg gagatcagac cacagagaca tgatgaaaag
3481 accctcgtgc agtcacaagt gaatgcttat aatgctgata tgattgaccc ttttcagttg
3541 ggccttctgg tcgtgttctt ggccacccag gaggtccttc gcaagaggtg gacagccaag
3601 atcagcatgc cagctatact gattgctctg ctagtcctgg tgtttggggg cattacttac
3661 actgatgtgt tacgctatgt catcttggtg ggggcagctt tcgcagaatc taattcggga
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3901 gtgttgaatt cactggcggt agcttggatg atactgagag ccataacatt cacaacgaca
3961 tcaaacgtgg ttgttccgct gctagccctg ctaacacccg ggctgagatg cttgaatctg
4021 gatgtgtaca ggatactgct gttgatggtc ggaataggca gcttgatcag ggagaagagg
4081 agtgcagctg caaaaaagaa aggagcaagt ctgctatgct tggctctagc ctcaacagga
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4201 ggatggcccg caactgaagt gatgacagct gtcggcctaa tgtttgccat cgtcggaggg
4261 ctggcagagc ttgacattga ctccatggcc attccaatga ctatcgcggg gctcatgttt
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4381 tcctgggaaa gtgatgcaga aattacaggc tcgagcgaaa gagttgatgt gcggcttgat
4441 gatgatggaa acttccagct catgaatgat ccaggagcac cttggaagat atggatgctc
4501 agaatggtct gtctcgcgat tagtgcgtac acccccctgg caatcttgcc ctcagtagtt
4561 ggattttgga taactctcca atacacaaag agaggaggcg tgttgtggga cactccctca
4621 ccaaaggagt acaaaaaggg ggacacgacc accggcgtct acaggatcat gactcgtggg
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4801 ggcagtgtca aggaggatcg actttgttac ggaggaccct ggaaattgca gcacaagtgg
4861 aacgggcagg atgaggtgca gatgattgtg gtggaacctg gcaagaacgt taagaacgtc
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5101 aggatggatg agccaatccc agccggattc gaacctgaga tgctgaggaa aaaacagatc
5161 actgtactgg atctccatcc cggcgccggt aaaacaagga ggattctgcc acagatcatc
5221 aaagaggcca taaacagaag actgagaaca gccgtgctag caccaaccag ggttgtggct
5281 gctgagatgg ctgaagcact gagaggactg cccatccggt accagacatc cgcagtgccc
5341 agagaacata atggaaatga gattgttgat gtcatgtgtc atgctaccct cacccacagg
5401 ctgatgtctc ctcacagggt gccgaactac aacctgttcg tgatggatga ggctcatttc
5461 accgacccag ctagcattgc agcaagaggt tacatttcca caaaggtcga gctaggggag
5521 gcggcggcaa tattcatgac agccacccca ccaggcactt cagatccatt cccagagtcc
5581 aattcaccaa tttccgactt acagactgag atcccggatc gagcttggaa ctctggatac
5641 gaatggatca cagaatacac cgggaagacg gtttggtttg tgcctagtgt caagatgggg
5701 aatgagattg ccctttgcct acaacgtgct ggaaagaaag tagtccaatt gaacagaaag
5761 tcgtacgaga cggagtaccc aaaatgtaag aacgatgatt gggactttgt tatcacaaca
5821 gacatatctg aaatgggggc taacttcaag gcgagcaggg tgattgacag ccggaagagt
5881 gtgaaaccaa ccatcataac agaaggagaa gcgagagtga tcctgggaga accatctgca
5941 gtgacagcag ctagtgccgc ccagagacgt ggacgtatcg gtagaaatcc gtcgcaagtt
6001 ggtgatgagt actgttatgg ggggcacacg aatgaagacg actcgaactt cgcccattgg
6061 actgaggcac gaatcatgct ggacaacatc aacatgccaa acggactgat cgctcaattc
6121 taccaaccag agcgtgagaa ggtatatacc atggatgggg aataccggct cagaggagaa
6181 gagagaaaaa actttctgga actgttgagg actgcagatc tgccagtttg gctggcttac
6241 aaggttgcag cggctggagt gtcataccac gaccggaggt ggtgctttga tggtcctagg
6301 acaaacacaa ttttagaaga caacaacgaa gtggaagtca tcacgaagct tggtgaaagg
6361 aagattctga ggccgcgctg gattgacgcc agggtgtact cggatcacca ggcactaaag
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FIG. 37c

```
6421 gcgttcaagg acttcgcctc gggaaaacgt tctcagatag ggctcattga ggttctggga
6481 aagatgcctg agcacttcat ggggaagaca tgggaagcac ttgacaccat gtacgttgtg
6541 gccactgcag agaaaggagg aagagctcac agaatggccc tggaggaact gccagatgct
6601 cttcagacaa ttgccttgat tgccttattg agtgtgatga ccatgggagt attcttcctc
6661 ctcatgcagc ggaagggcat tggaaagata ggtttgggag gcgctgtctt gggagtcgcg
6721 acctttttct gttggatggc tgaagttcca ggaacgaaga tcgccggaat gttgctgctc
6781 tcccttctct tgatgattgt gctaattcct gagccagaga agcaacgttc gcagacagac
6841 aaccagctag ccgtgttcct gatttgtgtc atgacccttg tgagcgcagt ggcagccaac
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6961 gaggtcaagg agaatttcag catgggagag tttcttctgg acttgaggcc ggcaacagcc
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7081 tcagattaca tcaacacctc attgacctca ataaacgttc aggcaagtgc actattcaca
7141 ctcgcgcgag gcttcccctt cgtcgatgtt ggagtgtcgg ctctcctgct agcagccgga
7201 tgctggggac aagtcaccct caccgttacg gtaacagcgg caacactcct tttttgccac
7261 tatgcctaca tggttcccgg ttggcaagct gaggcaatgc gctcagccca gcggcggaca
7321 gcggccggaa tcatgaagaa cgctgtagtg gatggcatcg tggccacgga cgtcccagaa
7381 ttagagcgca ccacacccat catgcagaag aaagttggac agatcatgct gatcttggtg
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7561 actgccatcg gactctgcca catcatgcgt gggggttggt tgtcatgtct atccataaca
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8701 gacactactc ccttcgggca gcagcgagtg ttcaaagaga aggtggacac gaaagctcct
8761 gaaccgccag aaggagtgaa gtacgtgctc aacgagacca ccaactggtt gtgggcgttt
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9001 ggggaatgtc acacttgcat ttacaacatg atgggaaaga gagagaaaaa acccggagag
9061 ttcggaaagg ccaagggaag cagagccatt tggttcatgt ggctcggagc tcgctttctg
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9241 cggcctgggg gcaagatcta tgctgatgac acagctggct gggacacccg catcacgaga
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9361 gccagggcca tcattgagct cacctatcgt cacaaagttg tgaaagtgat gcgcccggct
9421 gctgatggaa gaaccgtcat ggatgttatc tccagagaag atcagagggg gagtggacaa
9481 gttgtcacct acgccctaaa cactttcacc aacctggccg tccagctggt gaggatgatg
9541 gaaggggaag gagtgattgg cccagatgat gtggagaaac tcacaaaagg gaaaggaccc
9601 aaagtcagga cctggctgtt tgagaatggg gaagaaagac tcagccgcat ggctgtcagt
9661 ggagatgact gtgtggtaaa gcccctggac gatcgctttg ccacctcgct ccacttcctc
```

Nucleotide sequence of GenBank accession No. AF206518 (WVN isolate 2741)

FIG. 37d

```
 9721 aatgctatgt caaaggttcg caaagacatc caagagtgga aaccgtcaac tggatggtat
 9781 gattggcagc aggttccatt ttgctcaaac catttcactg aattgatcat gaaagatgga
 9841 agaacactgg tggttccatg ccgaggacag gatgaattgg taggcagagc tcgcatatct
 9901 ccaggggccg gatggaacgt ccgcgacact gcttgtctgg ctaagtctta tgcccagatg
 9961 tggctgcttc tgtacttcca cagaagagac ctgcggctca tggccaacgc catttgctcc
10021 gctgtccctg tgaattgggt ccctaccgga agaaccacgt ggtccatcca tgcaggagga
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10141 gaatggatgg aagacaaaac cccagtggag aaatggagtg acgtcccata ttcaggaaaa
10201 cgagaggaca tctggtgtgg cagcctgatt ggcacaagag cccgagccac gtgggcagaa
10261 aacatccagg tggctatcaa ccaagtcaga gcaatcatcg gagatgagaa gtatgtggat
10321 tacatgagtt cactaaagag atatgaagac acaactttgg ttgaggacac agtactgtag
10381 atatttaatt aattgtaaat agacaatata agtatgcata aaagtgtagt tttatagtag
10441 tatttagtgg tgttagtgta aatagttaag aaaattttga ggagaaagtc aggccgggaa
10501 gttcccgcca ccggaagttg agtagacggt gctgcctgcg actcaacccc aggaggactg
10561 ggtgaacaaa gccgcgaagt gatccatgta agccctcaga accgtctcgg aaggaggacc
10621 ccacatgttg taacttcaaa gcccaatgtc agaccacgct acggcgtgct actctgcgga
10681 gagtgcagtc tgcgatagtg ccccaggagg actgggttaa caaaggcaaa ccaacgcccc
10741 acgcggccct agccccggta atggtgttaa ccagggcgaa aggactagag gttagaggag
10801 accccgcggt ttaaagtgca cggcccagcc tggctgaagc tgtaggtcag gggaaggact
10861 agaggttagt ggagaccccg tgccacaaaa caccacaaca aaacagcata ttgacacctg
10921 ggatagacta ggagatcttc tgctctgcac aaccagccac acggcacagt gcgcc
//
```

Nucleotide sequence of GenBank accession No. AF404756 (WVN isolate 3356)

FIG. 38a

```
   1 agtagttcgc ctgtgtgagc tgacaaactt agtagtgttt gtgaggatta acaacaatta
  61 acacagtgcg agctgtttct tagcacgaag atctcgatgt ctaagaaacc aggagggccc
 121 ggcaagagcc gggctgtcaa tatgctaaaa cgcggaatgc cccgcgtgtt gtccttgatt
 181 ggactgaaga gggctatgtt gagcctgatc gacggcaagg ggccaatacg atttgtgttg
 241 gctctcttgg cgttcttcag gttcacagca attgctccga cccgagcagt gctggatcga
 301 tggagaggtg tgaacaaaca aacagcgatg aaacaccttc tgagttttaa gaaggaacta
 361 gggaccttga ccagtgctat caatcggcgg agctcaaaac aaaagaaaag aggaggaaag
 421 accggaattg cagtcatgat tggcctgatc gccagcgtag gagcagttac cctctctaac
 481 ttccaaggga aggtgatgat gacggtaaat gctactgacg tcacagatgt catcacgatt
 541 ccaacagctg ctggaaagaa cctatgcatt gtcagagcaa tggatgtggg atacatgtgc
 601 gatgatacta tcacttatga atgcccagtg ctgtcggctg gtaatgatcc agaagacatc
 661 gactgttggt gcacaaagtc agcagtctac gtcaggtatg gaagatgcac caagacacgc
 721 cactcaagac gcagtcggag gtcactgaca gtgcagacac acggagaaag cactctagcg
 781 aacaagaagg gggcttggat ggacagcacc aaggccacaa ggtatttggt aaaaacagaa
 841 tcatggatct tgaggaaccc tggatatgcc ctggtggcag ccgtcattgg ttggatgctt
 901 gggagcaaca ccatgcagag agttgtgttt gtcgtgctat tgcttttggt ggccccagct
 961 tacagcttca actgccttgg aatgagcaac agagacttct tggaaggagt gtctggagca
1021 acatgggtgg atttggttct cgaaggcgac agctgcgtga ctatcatgtc taaggacaag
1081 cctaccatcg atgtgaagat gatgaatatg gaggcggcca acctggcaga ggtccgcagt
1141 tattgctatt tggctaccgt cagcgatctc tccaccaaag ctgcgtgccc gaccatggga
1201 gaagctcaca atgacaaacg tgctgaccca gcttttgtgt gcagacaagg agtggtggac
1261 aggggctggg gcaacggctg cggattattt ggcaaaggaa gcattgacac atgcgccaaa
1321 tttgcctgct ctaccaaggc aataggaaga accatcttga aagagaatat caagtacgaa
1381 gtggccattt ttgtccatgg accaactact gtggagtcgc acggaaacta ctccacacag
1441 gttggagcca ctcaggcagg gagattcagc atcactcctg cggcgccttc atacacacta
1501 aagcttggag aatatggaga ggtgacagtg gactgtgaac cacggtcagg gattgacacc
1561 aatgcatact acgtgatgac tgttggaaca aagacgttct tggtccatcg tgagtggttc
1621 atggacctca acctcccttg gagcagtgct ggaagtactg tgtggaggaa cagagagacg
1681 ttaatggagt ttgaggaacc acacgccacg aagcagtctg tgatagcatt gggctcacaa
1741 gagggagctc tgcatcaagc tttggctgga gccattcctg tggaattttc aagcaacact
1801 gtcaagttga cgtcgggtca tttgaagtgt agagtgaaga tggaaaaatt gcagttgaag
1861 ggaacaacct atggcgtctg ttcaaaggct ttcaagtttc ttgggactcc cgcagacaca
1921 ggtcacggca ctgtggtgtt ggaattgcag tacactggca cggatggacc ttgtaaagtt
1981 cctatctcgt cagtggcttc attgaacgac ctaacgccag tgggcagatt ggtcactgtc
2041 aacccttttg tttcagtggc cacggccaac gctaaggtcc tgattgaatt ggaaccaccc
2101 tttggagact catacatagt ggtgggcaga ggagaacaac agatcaatca ccattggcac
2161 aagtctggaa gcagcattgg caaagccttt acaaccaccc tcaaaggagc gcagagacta
2221 gccgctctag gagacacagc ttgggacttt ggatcagttg gaggggtgtt cacctcagtt
2281 gggaaggctg tccatcaagt gttcggagga gcattccgct tactgttcgg aggcatgtcc
2341 tggataacgc aaggattgct gggggctctc ctgttgtgga tgggcatcaa tgctcgtgat
2401 aggtccatag ctctcacgtt tctcgcagtt ggaggagttc tgctcttcct ctccgtgaac
2461 gtgcacgctg acactgggtg tgccatagac atcagccggc aagagctgag atgtggaagt
2521 ggagtgttca tacacaatga tgtggaggct tggatggacc gatacaagta ttaccctgaa
2581 acgccacaag gcctagccaa gatcattcag aaagctcata aggaaggagt gtcggtcta
2641 cgatcagttt ccagactgga gcatcaaatg tgggaagcag tgaaggacga gctgaacact
2701 cttttgaagg agaatggtgt ggaccttagt gtcgtggttg agaaacagga gggaatgtac
2761 aagtcagcac ctaaacgcct caccgccacc acggaaaaat tggaaattgg ctggaaggcc
2821 tggggaaaga gtattttatt tgcaccagaa ctcgccaaca acacctttgt ggttgatggt
2881 ccggagacca aggaatgtcc gactcagaat cgcgcttgga atagcttaga agtggaggat
2941 tttggatttg gtctcaccag cactcggatg ttcctgaagg tcagagagag caacacaact
3001 gaatgtgact cgaagatcat tggaacggct gtcaagaaca acttggcgat ccacagtgac
3061 ctgtcctatt ggattgaaag caggctcaat gatacgtgga agcttgaaag ggcagttctg
3121 ggtgaagtca aatcatgtac gtggcctgag acgcatacct tgtggggcga tggaatcctt
3181 gagagtgact tgataatacc agtcacactg gcgggaccac gaagcaatca caatcggaga
```

Nucleotide sequence of GenBank accession No. AF404756 (WVN isolate 3356)

FIG. 38b

```
3241 cctgggtaca agacacaaaa ccagggccca tgggacgaag gccgggtaga gattgacttc
3301 gattactgcc caggaactac ggtcaccctg agtgagagct gcggacaccg tggacctgcc
3361 actcgcacca ccacagagag cggaaagttg ataacagatt ggtgctgcag gagctgcacc
3421 ttaccaccac tgcgctacca aactgacagc ggctgttggt atggtatgga gatcagacca
3481 cagagacatg atgaaaagac cctcgtgcag tcacaagtga atgcttataa tgctgatatg
3541 attgaccctt ttcagttggg ccttctggtc gtgttcttgg ccacccagga ggtccttcgc
3601 aagaggtgga cagccaagat cagcatgcca gctatactga ttgctctgct agtcctggtg
3661 tttgggggca ttacttacac tgatgtgtta cgctatgtca tcttggtggg ggcagctttc
3721 gcagaatcta attcgggagg agacgtggta cacttggcgc tcatggcgac cttcaagata
3781 caaccagtgt ttatggtggc atcgtttctc aaagcgagat ggaccaacca ggagaacatt
3841 ttgttgatgt tggcggctgt tttctttcaa atggcttatc acgatgcccg ccaaattctg
3901 ctctgggaga tccctgatgt gttgaattca ctggcggtag cttggatgat actgagagcc
3961 ataacattca caacgacatc aaacgtggtt gttccgctgc tagccctgct aacacccggg
4021 ctgagatgct tgaatctgga tgtgtacagg atactgctgt tgatggtcgg aataggcagc
4081 ttgatcaggg agaagaggag tgcagctgca aaaaagaaag gagcaagtct gctatgcttg
4141 gctctagcct caacaggact tttcaacccc atgatccttg ctgctggact gattacatgt
4201 gatcccaacc gtaaacgcgg atggcccgca actgaagtga tgacagctgt cggcctgatg
4261 tttgccatcg tcggagggct ggcagagctt gacattgact ccatggccat tccaatgact
4321 atcgcggggc tcatgtttgc tgctttcgtg atttctggga aatcaacaga tatgtggatt
4381 gagagaacgg cggacatttc ctgggaaagt gatgcagaaa ttacaggctc gagcgaaaga
4441 gttgatgtgc ggcttgatga tgatggaaac ttccagctca tgaatgatcc aggagcacct
4501 tggaagatat ggatgctcag aatggtctgt ctcgcgatta gtgcgtacac cccctgggca
4561 atcttgccct cagtagttgg attttggata actctccaat acacaaagag aggaggcgtg
4621 ttgtgggaca ctccctcacc aaaggagtac aaaaaggggg acacgaccac cggcgtctac
4681 aggatcatga ctcgtgggct gctcggcagt tatcaagcag gagcgggcgt gatggttgaa
4741 ggtgttttcc acacccttg gcatacaaca aaaggagccg ctttgatgag cggagagggc
4801 cgcctggacc catactgggg cagtgtcaag gaggatcgac tttgttacgg aggaccctgg
4861 aaattgcagc acaagtggaa cgggcaggat gaggtgcaga tgattgtggt ggaacctggc
4921 aagaacgtta agaacgtcca gacgaaacca ggggtgttca aaacacctga aggagaaatc
4981 ggggccgtga ctttggactt ccccactgga acatcaggct caccaatagt ggacaaaaac
5041 ggtgatgtga ttgggcttta tggcaatgga gtcataatgc ccaacggctc atacataagc
5101 gcgatagtgc agggtgaaag gatggatgag ccaatcccag ccggattcga acctgagatg
5161 ctgaggaaaa aacagatcac tgtactggat ctccatcccg gcgccggtaa aacaaggagg
5221 attctgccac agatcatcaa agaggccata aacagaagac tgagaacagc cgtgctagca
5281 ccaaccaggg ttgtggctgc tgagatggct gaagcactga gaggactgcc catccggtac
5341 cagacatccg cagtgcccag agaacataat ggaaatgaga ttgttgatgt catgtgtcat
5401 gctaccctca cccacaggct gatgtctcct cacagggtgc cgaactacaa cctgttcgtg
5461 atggatgagg ctcatttcac cgacccagct agcattgcag caagaggtta catttccaca
5521 aaggtcgagc taggggaggc ggcggcaata ttcatgacag ccaccccacc aggcacttca
5581 gatccattcc cagagtccaa ttcaccaatt tccgacttac agactgagat cccggatcga
5641 gcttggaact ctggatacga atggatcaca gaatacaccg ggaagacggt ttggtttgtg
5701 cctagtgtca agatggggaa tgagattgcc ctttgcctac aacgtgctgg aaagaaagta
5761 gtccaattga acagaaagtc gtacgagacg gagtacccaa aatgtaagaa cgatgattgg
5821 gactttgtta tcacaacaga catatctgaa atgggggcta actttaaggc gagcagggtg
5881 attgacagcc ggaagagtgt gaaaccaacc atcataacag aaggagaagg gagagtgatc
5941 ctgggagaac catctgcagt gacagcagct agtgccgccc agagacgtgg acgtatcggt
6001 agaaatccgt cgcaagttgg tgatgagtac tgttatgggg ggcacacgaa tgaagacgac
6061 tcgaacttcg cccattggac tgaggcacga atcatgctgg acaacatcaa catgccaaac
6121 ggactgatcg ctcaattcta ccaaccagag cgtgagaagg tatataccat ggatggggaa
6181 taccggctca gaggagaaga gagaaaaaac tttctggaac tgttgaggac tgcagatctg
6241 ccagtttggc tggcttacaa ggttgcagcg gctggagtgt cataccacga ccggaggtgg
6301 tgctttgatg gtcctaggac aaacacaatt ttagaagaca acaacgaagt ggaagtcatc
6361 acgaagcttg gtgaaaggaa gattctgagg ccgcgctgga ttgacgccag ggtgtactcg
6421 gatcaccagg cactaaaggc gttcaaggac ttcgcctcgg gaaaacgttc tcagataggg
6481 ctcattgagg ttctgggaaa gatgcctgag cacttcatgg ggaagacatg ggaagcactt
```

FIG. 38c

```
6541 gacaccatgt acgttgtggc cactgcagag aaaggaggaa gagctcacag aatggccctg
6601 gaggaactgc cagatgctct tcagacaatt gccttgattg ccttattgag tgtgatgacc
6661 atgggagtat tcttcctcct catgcagcgg aagggcattg gaaagatagg tttgggaggc
6721 gctgtcttgg gagtcgcgac ctttttctgt tggatggctg aagttccagg aacgaagatc
6781 gccggaatgt tgctgctctc ccttctcttg atgattgtgc taattcctga gccagagaag
6841 caacgttcgc agacagacaa ccagctagcc gtgttcctga tttgtgtcat gacccttgtg
6901 agcgcagtgg cagccaacga gatgggttgg ctagataaga ccaagagtga cataagcagt
6961 ttgtttgggc aaagaattga ggtcaaggag aatttcagca tgggagagtt tcttctggac
7021 ttgaggccgg caacagcctg gtcactgtac gctgtgacaa cagcggtcct cactccactg
7081 ctaaagcatt tgatcacgtc agattacatc aacacctcat tgacctcaat aaacgttcag
7141 gcaagtgcac tattcacact cgcgcgaggc ttccccttcg tcgatgttgg agtgtcggct
7201 ctcctgctag cagccggatg ctggggacaa gtcaccctca ccgttacggt aacagcggca
7261 acactccttt tttgccacta tgcctacatg gttcccggtt ggcaagctga ggcaatgcgc
7321 tcagcccagc ggcggacagc ggccggaatc atgaagaacg ctgtagtgga tggcatcgtg
7381 gccacggacg tcccagaatt agagcgcacc acacccatca tgcagaagaa agttggacag
7441 atcatgctga tcttggtgtc tctagctgca gtagtagtga acccgtctgt gaagacagta
7501 cgagaagccg gaattttgat cacggccgca gcggtgacgc tttgggagaa tggagcaagc
7561 tctgtttgga acgcaacaac tgccatcgga ctctgccaca tcatgcgtgg gggttggttg
7621 tcatgtctat ccataacatg gacactcata aagaacatgg aaaaaccagg actaaaaaga
7681 ggtggggcaa aaggacgcac cttgggagag gtttggaaag aaagactcaa ccagatgaca
7741 aaagaagagt tcactaggta ccgcaaagag gccatcatcg aagtcgatcg ctcagcagca
7801 aaacacgcca ggaaagaagg caatgtcact ggagggcatc cagtctctag gggcacagca
7861 aaactgagat ggctggtcga acggaggttt ctcgaaccgg tcggaaaagt gattgacctt
7921 ggatgtggaa gaggcggttg gtgttactat atggcaaccc aaaaaagagt ccaagaagtc
7981 agagggtaca caaagggcgg tcccggacat gaagagcccc aactagtgca aagttatgga
8041 tggaacattg tcaccatgaa gagtggggtg gatgtgttct acagaccttc tgagtgttgt
8101 gacaccctcc tttgtgacat cggagagtcc tcgtcaagtg ctgaggttga agagcatagg
8161 acgattcggg tccttgaaat ggttgaggac tggctgcacc gagggccaag ggaattttgc
8221 gtgaaggtgc tctgccccta catgccgaaa gtcatagaga agatggagct gctccaacgc
8281 cggtatgggg ggggactggt cagaaaccca ctctcacgga attccacgca cgagatgtat
8341 tgggtgagtc gagcttcagg caatgtggta cattcagtga atatgaccag ccaggtgctc
8401 ctaggaagaa tggaaaaaag gacctggaag ggaccccaat acgaggaaga tgtaaacttg
8461 ggaagtggaa ccagggcggt gggaaaaccc ctgctcaact cagacaccag taaaatcaag
8521 aacaggattg aacgactcag gcgtgagtac agttcgacgt ggcaccacga tgagaaccac
8581 ccatatagaa cctggaacta tcacggcagt tatgatgtga agcccacagg ctccgccagt
8641 tcgctggtca atggagtggt caggctcctc tcaaaaccat gggacaccat cacgaatgtt
8701 accaccatgg ccatgactga cactactccc ttcgggcagc agcgagtgtt caaagagaag
8761 gtggacacga aagctcctga accgccagaa ggagtgaagt acgtgctcaa cgagaccacc
8821 aactggttgt gggcgttttt ggccagagaa aaacgtccca gaatgtgctc tcgagaggaa
8881 ttcataagaa aggtcaacag caatgcagct ttgggtgcca tgtttgaaga gcagaatcaa
8941 tggaggagcg ccagagaggc agttgaagat ccaaaatttt gggagatggt ggatgaggag
9001 cgcgaggcac atctgcgggg ggaatgtcac acttgcattt acaacatgat gggaaagaga
9061 gagaaaaaac ccggagagtt cggaaaggcc aagggaagca gagccatttg gttcatgtgg
9121 ctcggagctc gctttctgga gttcgaggct ctgggttttc tcaatgaaga ccactggctt
9181 ggaagaaaga actcaggagg aggtgtcgag ggcttgggcc tccaaaaact gggttacatc
9241 ctgcgtgaag ttggcacccg gcctgggggc aagatctatg ctgatgacac agctggctgg
9301 gacacccgca tcacgagagc tgacttggaa aatgaagcta aggtgcttga gctgcttgat
9361 ggggaacatc ggcgtcttgc cagggccatc attgagctca cctatcgtca caaagttgtg
9421 aaagtgatgc gcccggctgc tgatggaaga accgtcatgg atgttatctc cagagaagat
9481 cagaggggga gtggacaagt tgtcacctac gccctaaaca ctttcaccaa cctggccgtc
9541 cagctggtga ggatgatgga aggggaagga gtgattggcc cagatgatgt ggagaaactc
9601 acaaaaggga aaggacccaa agtcaggacc tggctgtttg agaatgggga agaaagactc
9661 agccgcatgg ctgtcagtgg agatgactgt gtggtaaagc ccctggacga tcgctttgcc
9721 acctcgctcc acttcctcaa tgctatgtca aaggttcgca aagacatcca agagtggaaa
9781 ccgtcaactg gatggtatga ttggcagcag gttccatttt gctcaaacca tttcactgaa
```

Nucleotide sequence of GenBank accession No. AF404756 (WVN isolate 3356)

FIG. 38d

```
 9841 ttgatcatga aagatggaag aacactggtg gttccatgcc gaggacagga tgaattggta
 9901 ggcagagctc gcatatctcc aggggccgga tggaacgtcc gcgacactgc ttgtctggct
 9961 aagtcttatg cccagatgtg gctgcttctg tacttccaca gaagagacct gcggctcatg
10021 gccaacgcca tttgctccgc tgtccctgtg aattgggtcc ctaccggaag aaccacgtgg
10081 tccatccatg caggaggaga gtggatgaca acagaggaca tgttggaggt ctggaaccgt
10141 gtttggatag aggagaatga atggatggaa gacaaaaccc cagtggagaa atggagtgac
10201 gtcccatatt caggaaaacg agaggacatc tggtgtggca gcctgattgg cacaagagcc
10261 cgagccacgt gggcagaaaa catccaggtg gctatcaacc aagtcagagc aatcatcgga
10321 gatgagaagt atgtggatta catgagttca ctaaagagat atgaagacac aactttggtt
10381 gaggacacag tactgtagat atttaatcaa ttgtaaatag acaatataag tatgcataaa
10441 agtgtagttt tatagtagta tttagtggtg ttagtgtaaa tagttaagaa aattttgagg
10501 agaaagtcag gccgggaagt tcccgccacc ggaagttgag tagacggtgc tgcctgcgac
10561 tcaaccccag gaggactggg tgaacaaagc cgcgaagtga tccatgtaag ccctcagaac
10621 cgtctcggaa ggaggacccc acatgttgta acttcaaagc ccaatgtcag accacgctac
10681 ggcgtgctac tctgcggaga gtgcagtctg cgatagtgcc ccaggaggac tgggttaaca
10741 aaggcaaacc aacgccccac gcggccctag ccccggtaat ggcgttaacc agggcgaaag
10801 gactagaggt tagaggagac cccgcggttt aaagtgcacg gcccagcctg gctgaagctg
10861 taggtcaggg gaaggactag aggttagtgg agaccccgtg ccacaaaaca ccacaacaaa
10921 acagcatatt gacacctggg atagactagg agatcttctg ctctgcacaa ccagccacac
10981 ggcacagtgc gccgacaatg gtggctggtg gtgcgagaac acaggatct
```

Nucleotide sequence of DENV-1 GenBank accession No. U88535

FIG. 39a

```
   1 agttgttagt ctacgtggac cgacaagaac agtttcgaat cggaagcttg cttaacgtag
  61 ttctaacagt tttttattag agagcagatc tctgatgaac aaccaacgga aaaagacggg
 121 tcgaccgtct ttcaatatgc tgaaacgcgc gagaaaccgc gtgtcaactg tttcacagtt
 181 ggcgaagaga ttctcaaaag gattgctttc aggccaagga cccatgaaat tggtgatggc
 241 ttttatagca ttcctaagat ttctagccat acctccaaca gcaggaattt tggctagatg
 301 gggctcattc aagaagaatg gagcgatcaa agtgttacgg ggtttcaaga aagaaatctc
 361 aaacatgttg aacataatga acaggaggaa aagatctgtg accatgctcc tcatgctgct
 421 gcccacagcc ctggcgttcc atctgaccac ccgaggggga gagccgcaca tgatagttag
 481 caagcaggaa agaggaaaat cacttttgtt taagacctct gcaggtgtca acatgtgcac
 541 ccttattgca atggatttgg gagagttatg tgaggacaca atgacctaca aatgcccccg
 601 gatcactgag acggaaccag atgacgttga ctgttggtgc aatgccacgg agacatgggt
 661 gacctatgga acatgttctc aaactggtga acaccgacga gacaaacgtt ccgtcgcact
 721 ggcaccacac gtagggcttg gtctagaaac aagaaccgaa acgtggatgt cctctgaagg
 781 cgcttggaaa caaatacaaa aagtggagac ctgggctctg agacacccag gattcacggt
 841 gatagccctt tttctagcac atgccatagg aacatccatc acccagaaag ggatcatttt
 901 tattttgctg atgctggtaa ctccatccat ggccatgcgg tgcgtgggaa taggcaacag
 961 agacttcgtg gaaggactgt caggagctac gtgggtggat gtggtactgg agcatggaag
1021 ttgcgtcact accatggcaa aagacaaacc aacactggac attgaactct tgaagacgga
1081 ggtcacaaac cctgccgtcc tgcgcaaact gtgcattgaa gctaaaatat caaacaccac
1141 caccgattcg agatgtccaa cacaaggaga agccacgctg gtggaagaac aggacacgaa
1201 ctttgtgtgt cgacgaacgt tcgtggacag aggctggggc aatggttgtg ggctattcgg
1261 aaaaggtagc ttaataacgt gtgctaagtt taagtgtgtg acaaaactgg aaggaaagat
1321 agtccaatat gaaaacttaa aatattcagt gatagtcacc gtacacactg gagaccagca
1381 ccaagttgga aatgagacca cagaacatgg aacaactgca accataacac ctcaagctcc
1441 cacgtcggaa atacagctga cagactacgg agctctaaca ttggattgtt cacctagaac
1501 agggctagac tttaatgaga tggtgttgtt gacaatggaa aaaaaatcat ggctcgtcca
1561 caaacaatgg tttctagact taccactgcc ttggacctcg ggggcttcaa catcccaaga
1621 gacttggaat agacaagact tgctggtcac atttaagaca gctcatgcaa aaaagcagga
1681 agtagtcgta ctaggatcac aagaaggagc aatgcacact gcgttgactg gagcgacaga
1741 aatccaaacg tctggaacga caacaatttt tgcaggacac ctgaaatgca gactaaaaat
1801 ggataaactg actttaaaag ggatgtcata tgtaatgtgc acagggtcat tcaagttaga
1861 gaaggaagtg gctgagaccc agcatggaac tgttctagtg caggttaaat acgaaggaac
1921 agatgcacca tgcaagatcc ccttctcgtc ccaagatgag aagggagtaa cccagaatgg
1981 gagattgata acagccaacc ccatagtcac tgacaaagaa aaaccagtca acattgaagc
2041 ggagccacct tttggtgaga gctacattgt ggtaggagca ggtgaaaaag ctttgaaact
2101 aagctggttc aagaagggaa gcagtatagg gaaaatgttt gaagcaactg cccgtggagc
2161 acgaaggatg gccatcctgg gagacactgc atgggacttc ggttctatag gaggggtgtt
2221 cacgtctgtg ggaaaactga tacaccagat ttttgggact gcgtatggag ttttgttcag
2281 cggtgtttct tggaccatga agataggaat agggattctg ctgacatggc taggattaaa
2341 ctcaaggagc acgtcccttt caatgacgtg tatcgcagtt ggcatggtca cgctgtacct
2401 aggagtcatg gttcaggcgg actcgggatg tgtaatcaac tggaaaggca gagaactcaa
2461 atgtggaagc ggcatttttg tcaccaatga agtccacacc tggacagagc aatataaatt
2521 ccaggccgac tcccctaaga gactatcagc ggccattggg aaggcatggg aggagggtgt
2581 gtgtggaatt cgatcagcca ctcgtctcga gaacatcatg tggaagcaaa tatcaaatga
2641 attaaaccac atcttacttg aaaatgacat gaaatttaca gtggtcgtag gagacgttag
2701 tggaatcttg gcccaaggaa agaaaatgat taggccacaa cccatggaac acaaatactc
2761 gtggaaaagc tggggaaaag ccaaaatcat aggagcagat gtacagaata ccaccttcat
2821 catcgacggc ccaaacaccc cagaatgccc tgataaccaa agagcatgga acatttggga
2881 agttgaagac tatggatttg gaattttcac gacaaacata tggttgaaat tgcgtgactc
2941 ctacactcaa gtgtgtgacc accggctaat gtcagctgcc atcaaggata gcaaagcagt
3001 ccatgctgac atggggtact ggatagaaag tgaaaagaac gagacttgga agttggcaag
3061 agcctccttc atagaagtta agacatgcat ctggccaaaa tcccacactc tatggagcaa
3121 tggagtcctg gaaagtgaga tgataatccc aaagatatat ggaggaccaa tatctcagca
3181 caactacaga ccaggatatt tcacacaaac agcagggccg tggcacttgg gcaagttaga
```

FIG. 39b

```
3241 actagatttt gatttatgtg aaggtaccac tgttgttgtg gatgaacatt gtggaaatcg
3301 aggaccatct cttagaacca caacagtcac aggaaagaca atccatgaat ggtgctgtag
3361 atcttgcacg ttaccccccc tacgtttcaa aggagaagac gggtgctggt acggcatgga
3421 aatcagacca gtcaaggaga aggaagagaa cctagttaag tcaatggtct ctgcagggtc
3481 aggagaagtg gacagttttt cactaggact gctatgcata tcaataatga tcgaagaggt
3541 aatgagatcc agatggagca gaaaaatgct gatgactgga acattggctg tgttcctcct
3601 tctcacaatg ggacaattga catggaatga tctgatcagg ctatgtatca tggttggagc
3661 caacgcttca gacaagatgg ggatgggaac aacgtaccta gctttgatgg ccactttcag
3721 aatgagacca atgttcgcag tcgggctact gtttcgcaga ttaacatcta gagaagttct
3781 tcttcttaca gttggattga gtctggtggc atctgtagaa ctaccaaatt ccttagagga
3841 gctaggggat ggacttgcaa tgggcatcat gatgttgaaa ttactgactg attttcagtc
3901 acatcagcta tgggctacct tgctgtcttt aacatttgtc aaaacaactt tttcattgca
3961 ctatgcatgg aagacaatgg ctatgatact gtcaattgta tctctcttcc ctttatgcct
4021 gtccacgact tctcaaaaaa caacatggct tccggtgttg ctgggatctc ttggatgcaa
4081 accactaacc atgtttctta taacagaaaa caaaatctgg ggaaggaaaa gctggcctct
4141 caatgaagga attatggctg ttggaatagt tagcattctt ctaagttcac ttctcaagaa
4201 tgatgtgcca ctagctggcc cactaatagc tggaggcatg ctaatagcat gttatgtcat
4261 atctggaagc tcggccgatt tatcactgga gaaagcggct gaggtctcct gggaagaaga
4321 agcagaacac tctggtgcct cacacaacat actagtggag gtccaagatg atggaaccat
4381 gaagataaag gatgaagaga gagatgacac actcaccatt ctcctcaaag caactctgct
4441 agcaatctca ggggtatacc caatgtcaat accggcgacc ctctttgtgt ggtatttttg
4501 gcagaaaaag aaacagagat caggagtgct atgggacaca cccagccctc cagaagtgga
4561 aagagcagtc cttgatgatg gcatttatag aattctccaa agaggattgt tgggcaggtc
4621 tcaagtagga gtaggagttt ttcaagaagg cgtgttccac acaatgtggc acgtcaccag
4681 gggagctgtc ctcatgtacc aagggaagag actggaacca agttgggcca gtgtcaaaaa
4741 agacttgatc tcatatggag gaggttggag gtttcaagga tcctggaacg cgggagaaga
4801 agtgcaggtg attgctgttg aaccggggaa gaaccccaaa aatgtacaga cagcgccggg
4861 taccttcaag acccctgaag gcgaagttgg agccatagct ctagacttta aacccggcac
4921 atctggatct cctatcgtga acagagaggg aaaaatagta ggtctttatg gaaatggagt
4981 ggtgacaaca agtggtacct acgtcagcgc catagctcaa gctaaagcat cacaagaagg
5041 gcctctacca gagattgagg acgaggtgtt taggaaaaga aacttaacaa taatggacct
5101 acatccagga tcgggggaaaa caagaagata tcttccagcc atagtccgtg aggccataag
5161 aaggaacgtg cgcacgctag tcttagctcc cacaagagtt gtcgcttctg aaatggcaga
5221 ggcgctcaag ggaatgccaa taaggtatca gacaacagca gtgaagagtg aacacacagg
5281 aaaagagata gttgacctta tgtgtcacgc cactttcact atgcgtctcc tgtctcctgt
5341 gagagttccc aattataata tgattatcat ggatgaagca cattttaccg atccagccag
5401 catagcagcc agagggtata tctcaacccg agtgggtatg ggtgaagcag ctgcgatttt
5461 catgacagcc actccccccg gatcggtgga ggcctttcca cagagcaatg cagttatcca
5521 agatgaggaa agagacattc ctgaaagatc atggaactca ggctatgact ggatcactga
5581 tttcccaggt aaaacagtct ggtttgttcc aagcatcaaa tcaggaaatg acattgccaa
5641 ctgtttaaga aagaatggga aacgggtggt ccaattgagc agaaaaactt ttgacactga
5701 gtaccagaaa acaaaaaata acgactggga ctatgttgtc acaacagaca tatccgaaat
5761 gggagcaaac ttccgagccg acagggtaat agacccgagg cggtgcctga aaccggtaat
5821 actaaaagat ggcccagagc gtgtcattct agccggaccg atgccagtga ctgtggctag
5881 cgccgcccag aggagaggaa gaattggaag gaaccaaaat aaggaaggcg atcagtatat
5941 ttacatggga cagcctctaa acaatgatga ggaccacgcc cattggacag aagcaaaaat
6001 gctccttgac aacataaaca caccagaagg gattatccca gccctctttg agccggagag
6061 agaaaagagt gcagcaatag acggggaata cagactacgg ggtgaagcga ggaaaacgtt
6121 cgtggagctc atgagaagag gagatctacc tgtctggcta tcctacaaag ttgcctcaga
6181 aggcttccag tactccgaca gaaggtggtg ctttgatggg gaaaggaaca accaggtgtt
6241 ggaggagaac atggacgtgg agatctggac aaaagaagga gaaagaaaga aactacgacc
6301 ccgctggctg gatgccagaa catactctga cccactggct ctgcgcgaat tcaaagagtt
6361 cgcagcagga agaagaagcg tctcaggtga cctaatatta gaaataggga aacttccaca
6421 acatttaacg caaagggccc agaacgcctt ggacaatctg gttatgttgc acaactctga
6481 acaaggagga aaagcctata gacacgccat ggaagaacta ccagacacca tagaaacgtt
```

FIG. 39c

```
6541 aatgctccta gctttgatag ctgtgctgac tggtggagtg acgttgttct tcctatcagg
6601 aaggggtcta ggaaaaacat ccattggcct actctgcgtg attgcctcaa gcgcactgct
6661 atggatggcc agtgtggaac cccattggat agcggcctct atcatactgg agttctttct
6721 gatggtgttg cttattccag agccggacag acagcgcact ccacaagaca accagctagc
6781 atacgtggtg ataggtctgt tattcatgat attgacagcg gcagccaatg agatgggatt
6841 actggaaacc acaaagaagg acctggggat tggtcatgca gctgctgaaa accaccatca
6901 tgctgcaatg ctggacgtag acctacatcc agcttcagcc tggactctct atgcagtggc
6961 cacaacaatt atcactccca tgatgagaca cacaattgaa aacacaacgg caaatatttc
7021 cctgacagct attgcaaacc aggcagctat attgatggga cttgacaagg gatggccaat
7081 atcaaagatg gacataggag ttccacttct cgccttgggg tgctattctc aggtgaaccc
7141 gctgacgctg acagcggcgg tatttatgct agtggctcat tatgccataa ttggacccgg
7201 actgcaagca aaagctacta gagaagctca aaaaaggaca gcagccggaa taatgaaaaa
7261 cccaactgtc gacgggatcg ttgcaataga tttggaccct gtggtttacg atgcaaaatt
7321 tgaaaaacag ctaggccaaa taatgttgtt gatactttgc acatcacaga tcctcctgat
7381 gcggaccaca tgggccttgt gtgaatccat cacactagcc actggacctc tgactacgct
7441 ttgggaggga tctccaggaa aattctggaa caccacgata gcggtgtcca tggcaaacat
7501 ttttagggga agttatctag caggagcagg tctggccttt tcattaatga aatctctagg
7561 aggaggtagg agaggcacgg gagcccaagg ggaaacactg ggagaaaaat ggaaaagaca
7621 gctaaaccaa ttgagcaagt cagaattcaa cacttacaaa aggagtggga ttatagaggt
7681 ggatagatct gaagccaaag aggggttaaa aagaggagaa ccgactaaac acgcagtgtc
7741 gagaggaacg gccaaactga ggtggtttgt ggagaggaac cttgtgaaac cagaagggaa
7801 agtcatagac ctcggttgtg gaagaggtgg ctggtcatat tattgcgctg ggctgaagaa
7861 agtcacagaa gtgaaaggat acacgaaagg aggacctgga catgaggaac caatcccaat
7921 ggcaacctat ggatggaacc tagtaaagct atactccggg aaagatgtat tctttacacc
7981 acctgagaaa tgtgacaccc tcttgtgtga tattggtgag tcctctccga acccaactat
8041 agaagaagga agaacgttac gtgttctaaa gatggtggaa ccatggctca gaggaaacca
8101 attttgcata aaaattctaa atccctatat gccgagtgtg gtagaaactt tggagcaaat
8161 gcaaagaaaa catggaggaa tgctagtgcg aaatccactc tcaagaaact ccactcatga
8221 aatgtactgg gtttcatgtg gaacaggaaa cattgtgtca gcagtaaaca tgacatctag
8281 aatgttgcta aatcgattca caatggctca caggaagcca acatatgaaa gagacgtgga
8341 cttaggcgct ggaacaagac atgtggcagt agaaccagag gtggccaacc tagatatcat
8401 tggccagagg atagagaata taaaaaatgg acacaaatca acatggcact atgatgagga
8461 caatccatac aaaacatggg cctatcatgg atcatatgag gtcaagccat caggatcagc
8521 ctcatccatg gtcaatggtg tggtgagact gctaaccaaa ccatgggatg tcattcccat
8581 ggtcacacaa atagccatga ctgacaccac acccttgga caacagaggg tgtttaaaga
8641 gaaagttgac acgcgtacac caaaagcgaa acgaggcaca gcacaaatta tggaggtgac
8701 agccaggtgg ttatggggtt ttctctctag aaacaaaaaa cccagaatct gcacaagaga
8761 ggagttcaca agaaaagtca ggtcaaacgc agctattgga gcagtgttcg ttgatgaaaa
8821 tcaatggaac tcagcaaaag aggcagtgga agatgaacgg ttctgggacc ttgtgcacag
8881 agagagggag cttcataaac aaggaaaatg tgccacgtgt gtctacaaca tgatgggaaa
8941 gagagagaaa aaattaggag agttcggaaa ggcaaaagga agtcgcgcaa tatggtacat
9001 gtggttggga gcgcgctttt tagagtttga agcccttggt ttcatgaatg aagatcactg
9061 gttcagcaga gagaattcac tcagtggagt ggaaggagaa ggactccaca aacttggata
9121 catactcaga gacatatcaa agattccagg gggaaatatg tatgcagatg acacagccgg
9181 atgggacaca agaataacag aggatgatct tcagaatgag gccaaaatca ctgacatcat
9241 ggaacctgaa catgccctat tggccacgtc aatctttaag ctaacctacc aaaacaaggt
9301 agtaagggtg cagagaccag cgaaaaatgg aaccgtgatg gatgtcatat ccagacgtga
9361 ccagagagga agtggacagg ttggaaccta tggcttaaac accttcacca acatggaggc
9421 ccaactaata agacaaatgg agtctgaggg aatcttttca cccagcgaat tggaaacccc
9481 aaatctagcc gaaagagtcc tcgactggtt gaaaaaacat ggcaccgaga ggctgaaaag
9541 aatggcaatc agtggagatg actgtgtggt gaaaccaatc gatgacagat ttgcaacagc
9601 cttaacagct ttgaatgaca tgggaaaggt aagaaaagac ataccgcaat gggaaccttc
9661 aaaaggatgg aatgattggc aacaagtgcc tttctgttca caccatttcc accagctgat
9721 tatgaaggat gggagggaga tagtggtgcc atgccgcaac caagatgaac ttgtaggtag
9781 ggccagagta tcacaaggcg ccggatggag cttgagagaa actgcatgcc taggcaagtc
```

FIG. 39d

```
 9841 atatgcacaa atgtggcagc tgatgtactt ccacaggaga gacttgagat tagcggctaa
 9901 tgctatctgt tcagccgttc cagttgattg ggtcccaacc agccgtacca cctggtcgat
 9961 ccatgcccac catcaatgga tgacaacaga agacatgttg tcagtgtgga atagggtttg
10021 gatagaggaa aacccatgga tggaggacaa gactcatgtg tccagttggg aagacgttcc
10081 atacctagga aaaagggaag atcgatggtg tggatcccta ataggcttaa cagcacgagc
10141 cacctgggcc accaacatac aagtggccat aaaccaagtg agaaggctca ttgggaatga
10201 gaattatcta gacttcatga catcaatgaa gagattcaaa aacgagagtg atcccgaagg
10261 ggcactctgg taagccaact cattcacaaa ataaaggaaa ataaaaaatc aaacaaggca
10321 agaagtcagg ccggattaag ccatagcacg gtaagagcta tgctgcctgt gagccccgtc
10381 caaggacgta aaatgaagtc aggccgaaag ccacggttcg agcaagccgt gctgcctgta
10441 gctccatcgt ggggatgtaa aaacccggga ggctgcaaac catggaagct gtacgcatgg
10501 ggtagcagac tagtggttag aggagacccc tcccaagaca caacgcagca gcggggccca
10561 acaccagggg aagctgtacc ctggtggtaa ggactagagg ttagaggaga ccccccgcac
10621 aacaacaaac agcatattga cgctgggaga gaccagagat cctgctgtct ctacagcatc
10681 attccaggca cagaacgcca aaaaatggaa tggtgctgtt gaatcaacag gttct
//
```

Nucleotide sequence of DENV-2 "New Guinea" GenBank accession No. AF038403

FIG. 40a

```
   1 agttgttagt ctacgtggac cgacaaagac agattctttg agggagctaa gctcaacgta
  61 gttctaacag ttttttaatt agagagcaga tctctgatga ataaccaacg aaaaaaggcg
 121 agaaataccc ctttcaatat gctgaaacgc gagagaaacc gcgtgtcgac tgtacaacag
 181 ctgacaaaga gattctcact tggaatgctg cagggacgag gaccattaaa actgttcatg
 241 gccctggtgg cgttccttcg tttcctaaca atcccaccaa cagcagggat actgaagaga
 301 tggggaacaa ttaaaaaatc aaaagccatt aatgttttga gagggttcag gaaagagatt
 361 ggaaggatgc tgaacatctt gaacaggaga cgcagaactg caggcatgat cattatgctg
 421 attccaacag tgatggcgtt ccatttaacc acacgtaacg gagaaccaca catgatcgtc
 481 agtagacaag agaaagggaa aagtcttctg tttaaaacag aggatggtgt gaacatgtgt
 541 accctcatgg ccatggacct tggtgaattg tgtgaagata caatcacgta caagtgtcct
 601 tttctcaggc agaatgaacc agaagacata gattgttggt gcaactctac gtccacatgg
 661 gtaacttatg ggacgtgtac caccacagga gaacacagaa gagaaaaaag atcagtggca
 721 ctcgttccac atgtgggaat gggactggag acacgaactg aaacatggat gtcatcagaa
 781 ggggcctgga aacatgccca gagaattgaa acttggatct tgagacatcc aggctttacc
 841 ataatggcag caatcctggc atacaccata ggaacgacac atttccaaag agccctgatt
 901 ttcatcttac tgacagctgt cgctccttca atgacaatgc gttgcatagg aatatcaaat
 961 agagactttg tagaaggggt ttcaggagga agctgggttg acatagtctt agaacatgga
1021 agctgtgtga cgacgatggc aaaaaacaaa ccaacattgg attttgaact gataaaaaca
1081 gaagccaaac aacctgccac tctaaggaag tactgtatag aggcaaagct gaccaacaca
1141 acaacagatt ctcgctgccc aacacaagga gaacccagcc taaatgaaga gcaggacaaa
1201 aggttcgtct gcaaacactc catggtggac agaggatggg gaaatggatg tggattattt
1261 ggaaaaggag gcattgtgac ctgtgctatg ttcacatgca aaaagaacat gaaaggaaaa
1321 gtcgtgcaac cagaaaactt ggaatacacc attgtgataa cacctcactc aggggaagag
1381 catgcagtcg gaaatgacac aggaaaacat ggcaaggaaa tcaaaataac accacagagt
1441 tccatcacag aagcagagtt gacaggctat ggcactgtca cgatggagtg ctctccgaga
1501 acgggcctcg acttcaatga gatggtgttg ctgcaaatgg aaaataaagc ttggctggtg
1561 cacaggcaat ggttcctaga cctgccgttg ccatggctgc ccggagcgga cacacaagga
1621 tcaaattgga tacagaaaga gacattggtc actttcaaaa atccccatgc gaagaaacag
1681 gatgttgttg ttttgggatc ccaagaaggg gccatgcaca cagcactcac aggggccaca
1741 gaaatccaga tgtcatcagg aaacttactg ttcacaggac atctcaagtg caggctgagg
1801 atggacaaac tacagctcaa aggaatgtca tactctatgt gcacaggaaa gtttaaagtt
1861 gtgaaggaaa tagcagaaac acaacatgga acaatagtta tcagagtaca atatgaaggg
1921 gacggttctc catgtaagat ccctttgag ataatggatt tggaaaaaag acatgtttta
1981 ggtcgcctga ttacagtcaa cccaatcgta acagaaaaag atagcccagt caacatagaa
2041 gcagaacctc cattcggaga cagctacatc atcataggag tagagccggg acaattgaag
2101 ctcaactggt ttaagaaagg aagttctatc ggccaaatga ttgagacaac aatgagggga
2161 gcgaagagaa tggccatttt aggtgacaca gcttgggatt ttggatccct gggaggagtg
2221 tttacatcta taggaaaggc tctccaccaa gttttcggag caatctatgg ggctgccttc
2281 agtggggtct catggactat gaaaatactc ataggagtca ttatcacatg gataggaatg
2341 aattcacgca gcacctcact gtctgtgtca ctagtattgg tgggagtcgt gacgctgtat
2401 ttgggagtta tggtgcaggc cgatagtggt tgcgttgtga gctggaaaaa caaagaactg
2461 aagtgtggca gtgggatttt catcacagac aacgtgcaca catggacaga acaatacaag
2521 ttccaaccag aatccccttc aaagctagct tcagctatcc agaaagctca tgaagagggc
2581 atttgtggaa tccgctcagt aacaagactg gaaaatctga tgtggaaaca aataacacca
2641 gaattgaatc acattctatc agaaaatgag gtgaagttga ctattatgac aggagacatc
2701 aaaggaatca tgcaggcagg aaaacgatct ctgcagcccc agcccactga gctgaagtat
2761 tcatggaaaa catggggcaa agcgaaaatg ctctctacag agtctcataa ccagaccttt
2821 ctcattgatg gccccgaaac agcagaatgc cccaacacaa acagagcttg gaattcgctg
2881 gaagttgaag actatggctt tggagtattc accaccaata tatggctaaa gttgagagaa
2941 aagcaggatg tattctgcga ctcaaaactc atgtcagcgg ccataaaaga caacagagcc
3001 gtccatgccg atatgggtta ttggatagaa agtgcactca atgacacatg gaagatagag
3061 aaagcctctt tcatcgaagt taaaagctgc cactggccaa agtcacacac cctctggagt
3121 aatggagtgt tagaaagtga gatgataatt ccaaagaatt tcgctggacc agtgtcacaa
3181 cacaactaca gaccaggcta ccatacacaa acagcaggac catggcatct aggtaagctt
```

FIG. 40b

```
3241 gagatggact ttgatttctg cgaaggaacc acagtggtgg tgactgagga ctgtggaaat
3301 agaggaccct ctttaagaac aactactgcc tctggaaaac tcataacaga atggtgctgc
3361 cgatcttgca cattaccacc gctaagatac agaggtgagg acggatgctg gtacgggatg
3421 gaaatcagac cattgaaaga gaaagaagag aatttggtca actccttggt cacagccgga
3481 catgggcaga ttgacaactt ttcactagga gtcttgggaa tggcattgtt cctggaagaa
3541 atgctcagga cccgagtagg aacgaaacat gcaatactac tagttgcagt ttcttttgtg
3601 acattgatca cagggaacat gtcctttaga gacctgggaa gagtgatggt tatggtgggc
3661 gctactatga cggatgacat aggtatgggc gtgacttatc ttgccctact agcagccttc
3721 aaagtcagac caacttttgc agctggacta ctcttgagaa agttgacctc caaggaattg
3781 atgatgacta ccataggaat cgtactcctc tcccagagca ccataccaga gaccattctt
3841 gaactgactg atgcgttagc cttgggcatg atggtcctta aaatggtgag aaaaatggaa
3901 aagtatcaat tggcagtgac tatcatggct atcttgtgcg tcccaaatgc agtgatatta
3961 caaaacgcat ggaaagtgag ttgcacaata ttggcagtgg tgtccgtttc cccactgttc
4021 ttaacatcct cacagcagaa agcggattgg ataccattag cattgacgat caagggtctc
4081 aatccaacag ctatttttct aacaaccctt tcaagaacca acaagaaaag gagctggcca
4141 ctaaatgagg ctatcatggc agtcgggatg gtgagcattt tggccagttc actcctaaag
4201 aatgacattc ccatgacagg accattagtg gctggagggc tcctcactgt gtgctacgtg
4261 ctcactggac gatcggccga tttggaactg gagagagccg ccgatgtcaa atgggaagat
4321 caggcagaga tatcaggaag cagtccaatc ctgtcaataa caatatcaga agatggtagc
4381 atgtcgataa aaaacgaaga ggaagaacaa acactgacca tactcattag aacaggattg
4441 ctggtgatct caggactttt tcctgtatca ataccaatca cggcagcagc atggtacctg
4501 tgggaagtga agaaacaacg ggctggagta ttgtgggatg tcccttcacc cccacccgtg
4561 ggaaaggctg aactggaaga tggagcctat agaatcaagc aaaaagggat tcttggatat
4621 tcccagatcg gagccggagt ttacaaagaa ggaacattcc atacaatgtg gcatgtcaca
4681 cgcggcgctg ttctaatgca taaaggaaag aggattgaac catcatgggc ggacgttaag
4741 aaagacctaa tatcatatgg aggaggctgg aagctagaag gagaatggaa ggaaggagaa
4801 gaagtccagg tcttggcatt ggagcctgga aaaaatccaa gagccgtcca aacaaaacct
4861 ggtcttttca aaaccaacgc cggaaccata ggtgccgtat ctctggactt ttctcctgga
4921 acctcaggat ctccaatcat cgacaaaaaa ggaaaagttg tgggtcttta tggtaatggt
4981 gttgttacaa ggagtggagc atatgtgagt gctatagccc agactgaaaa aagtattgaa
5041 gacaatccag agatcgaaga tgatattttt cgaaagagaa aattgaccat catggacctc
5101 cacccaggag cgggaaagac gaagagatac cttccggcca tagtcagaga ggctataaaa
5161 cggggcctga ggacattaat cctggccccc actagagtcg tggcagctga aatggaggaa
5221 gccctaagag gacttccaat aagataccaa accccagcca tcagagctga gcacaccggg
5281 cgggagattg tggacctaat gtgtcatgcc acattcacta tgaggctgct atcaccagtt
5341 agagtgccaa attacaacct gatcatcatg gacgaagccc atttcacaga cccagcaagt
5401 atagcggcta gaggatacat ctcaactcga gtagagatgg gtgaggcagc tgggattttc
5461 atgacagcca ctcctccggg aagcagagac ccattccctc agagcaatgc accaatcatg
5521 gatgaagaaa gagaaatccc tgaacgttcg tggagttctg gacatgagtg ggtcacggat
5581 tttaaaggga agactgtttg gttcgttcca agtataaaag caggaaatga tatagcagct
5641 tgcctgagaa aaaatggaaa gaaagtgata caactcagta ggaagacctt tgattctgag
5701 tatgtcaaga ctagaaccaa tgattgggac ttcgtggtca caactgacat ttcagaaatg
5761 ggtgccaact tcaaggctga gagggttata gaccccagac gctgcatgaa accagttata
5821 ctaacagatg gtgaagagcg ggtgatcctg gcaggaccta tgccagtgac ccactctagt
5881 gcagcacaaa gaagagggag aataggaaga aatccaaaaa atgaaaatga ccagtacata
5941 tacatggggg aacctctgga aaatgatgaa gactgtgcac actggaaaga agctaaaatg
6001 ctcctagata acatcaacac acctgaagga atcattccta gcatgttcga accagagcgt
6061 gaaaaggtgg atgccattga tggtgaatac cgcttgagag gagaagcaag gaaaaccttt
6121 gtggacctaa tgagaagagg agacctacca gtctggttgg cctacagagt ggcagctgaa
6181 ggcatcaact acgcagacag aaggtggtgt tttgatggaa ttaagaacaa ccaaatcttg
6241 gaagaaaatg tggaggtgga aatctggaca aaagaagggg aaaggaagaa attaaaaccc
6301 agatggttgg atgccaggat ctactctgac ccactgacgc taaaggaatt caaggagttt
6361 gcagctggaa gaaagtccct gaccctgaac ctaatcacag aaatgggtag gcttccaact
6421 ttcatgactc agaaggcaag agacgcactg gacaacttag cagtgctgca cacggctgaa
6481 gcaggtggaa gggcgtacaa tcatgctctc agtgaactgc cggagaccct ggagacattg
```

FIG. 40c

```
6541 cttttactga cacttctggc tacagtcaca ggaggaatct ttttattctt gatgagcgga
6601 aggggtatag ggaagatgac cctgggaatg tgctgcataa tcacggctag tattctccta
6661 tggtacgcac aaatacagcc acactggata gcagcttcaa taatactgga gtttttttctc
6721 atagttttgc ttattccaga accagaaaag cagagaacac cccaagataa ccaattgacc
6781 tacgttgtca tagccatcct cacagtggtg gccgcaacca tggcaaacga gatgggtttc
6841 ctggaaaaaa cgaagaaaga tctcggattg ggaagcatta caacccagca acccgagagc
6901 aacatcctgg acatagatct acgtcccgca tcagcatgga cgctgtatgc tgtggccaca
6961 acatttgtca caccaatgtt gagacacagc attgaaaatt cctcagtgaa cgtgtcccta
7021 acagctattg ccaaccaagc cacagtgtta atgggtcttg ggaaaggatg gccattgtca
7081 aagatggaca tcggagttcc ccttctcgcc attggatgct actcacaagt caaccccata
7141 actctcacag cagctctttt cttactggta gcacattatg ccatcatagg gccaggactc
7201 caagcaaaag caaccaggga agctcagaaa agagcagcag cgggcatcat gaaaaaccca
7261 actgtcgatg gaataacagt gattgaccta gatccaatac cctatgatcc aaagtttgaa
7321 aagcagttgg gacaagtaat gctcctagtc ctctgcgtga ctcaagtgtt gatgatgagg
7381 actacatggg ctctgtgtga ggctttaacc ttagcgaccg ggcctatctc cacattgtgg
7441 gaaggaaatc cagggaggtt ttggaacact accattgcag tgtcaatggc taacattttt
7501 agagggagtt acttggccgg agctggactt ctcttttcca tcatgaagaa cacaaccaac
7561 acgagaaggg gaactggcaa cataggagag acgcttggag agaaatggaa aagccgattg
7621 aacgcattgg ggaaaagtga attccagatc tacaagaaaa gtggaatcca ggaagtggat
7681 agaaccttag caaaagaagg cattaaaaga ggagaaacgg accatcacgc tgtgtcgcga
7741 ggctcagcaa aactgagatg gttcgtcgag agaaatatgg tcacaccaga agggaaagta
7801 gtggacctcg gttgcggcag aggaggctgg tcatactatt gtgggggact aaagaatgta
7861 agagaagtca aaggcctgac aaaaggagga ccaggacatg aagaacccat ccccatgtca
7921 acatatgggt ggaatctagt acgtcttcaa agtggagttg acgttttctt cactccgcca
7981 gaaaagtgtg acacattgtt gtgtgacata ggggagtcgt caccaaatcc cacggtagaa
8041 gcaggacgaa cactcagagt ccttaactta gtggaaaatt ggttgaacaa caacacccaa
8101 ttttgcataa aggttctcaa cccatacatg ccctcagtca tagaaaaaat ggaagcacta
8161 caaaggaaat atggaggagc cttagtgagg aatccactct cacgaaactc cacacatgag
8221 atgtactggg tatccaatgc ctccgggaac atagtgtcat cagtgaacat gatttcaagg
8281 atgttgatca acagattcac aatgagacac aagaaagcca cttacgagcc agatgtagac
8341 ctcggaagcg gaacccgcaa catcggaatt gaaagtgaga taccaaacct agacataatc
8401 gggaaaagaa tagaaaaaat aaaacaagag catgaaacat catggcacta tgaccaagac
8461 cacccataca aaacgtgggc ttaccatggc agctatgaaa caaaacaaac tggatcagca
8521 tcatccatgg tgaacggagt ggtcagactg ctgacaaaac cttgggacgt cgtccccatg
8581 gtgacacaga tggcaatgac agacacgact ccatttggac aacagcgcgt ttttaaagaa
8641 aaagtggaca cgagaaccca agaaccgaaa gaaggcacaa agaaactaat gaaaatcacg
8701 gcagagtggc tttggaaaga actagggaag aaaaagacac ctaggatgtg cactagagaa
8761 gaattcacaa gaaaggtgag aagcaatgca gccttggggg ccatattcac tgatgagaac
8821 aagtggaagt cggcacgtga ggctgttgaa gatagtaggt tttgggagct ggttgacaag
8881 gaaaggaatc tccatcttga aggaaagtgt gaaacatgtg tgtataacat gatgggaaaa
8941 agagagaaga agctagggga gttcggcaag gcaaaaggca gcagagccat atggtacatg
9001 tggcttggag cacgcttctt agagtttgaa gccctaggat tcttgaatga agatcactgg
9061 ttctccagag agaactcctt gagtggagtg gaaggagaag ggctgcacaa gctaggttac
9121 attttaagag acgtgagcaa gaaagaggga ggagcaatgt atgccgatga caccgcagga
9181 tgggacacaa gaatcacact agaagaccta aaaaatgaag aaatggtaac aaaccacatg
9241 gaaggagaac acaagaaact agccgaggcc attttcaaat taacgtacca aaacaaggtg
9301 gtgcgtgtgc aaagaccaac accaagaggc acagtaatgg atatcatatc gagaagagac
9361 caaagaggta gtggacaagt tggtacctat ggactcaata ctttcaccaa tatggaagcc
9421 caactaatca gacagatgga gggagaagga gtcttcaaaa gcattcagca cctgacagtc
9481 acagaagaaa tcgccgtgca aaactggtta gcaagagtag ggcgcgaaag gttatcaaga
9541 atggccatca gtggagatga ttgtgttgtg aaacctttag atgacaggtt cgcaagcgct
9601 ttaacagctc taaatgacat gggaaaggtt aggaaagaca tacaacaatg ggaaccttca
9661 agaggatgga acgattggac acaagtgccc ttctgttcac accatttcca tgagttaatc
9721 atgaaagacg gccgcgtact tgtagttcca tgcagaaacc aagatgaact gattggtaga
9781 gcccgaattt cccaaggagc tgggtggtct ttgcgagaga cggcctgttt ggggaagtcc
```

FIG. 40d

```
 9841 tacgcccaaa tgtggagctt gatgtacttc cacagacgtg acctcaggct ggcggctaat
 9901 gctatttgct cggcagtccc atcacattgg gttccaacaa gtagaacaac ctggtccata
 9961 cacgccaaac atgaatggat gacaacggaa gacatgctga cagtctggaa cagggtgtgg
10021 attcaagaaa acccatggat ggaagacaaa actccagtgg aatcatggga ggaaatccca
10081 tacttgggga aaagagaaga ccaatggtgc ggctcattga ttgggctaac aagcagggcc
10141 acctgggcaa agaacatcca aacagcaata aatcaagtta gatcccttat aggcaatgag
10201 gaatacacag attacatgcc atccatgaaa agattcagaa gagaagagga agaggcagga
10261 gtcctgtggt agaaggcaaa actaacatga aacaaggcta gaagtcaggt cggattaagc
10321 tatagtacgg aaaaaactat gctacctgtg agccccgtcc aaggacgtta aaagaagtca
10381 ggccattaca aatgccatag cttgagtaaa ctgtggcagc ctgtagctcc acctgagaag
10441 gtgtaaaaaa tctgggaggc cacaaaccat ggaagctgta cgcatggcgt agtggactag
10501 cggttagagg agacccctcc cttacaaatc gcagcaacaa tgggggccca aggtgagatg
10561 aagctgtagt ctcactggaa ggactagagg ttagaggaga ccccccccaaa acaaaaaaca
10621 gcatattgac gctgggaaag accagagatc ctgctgtctc ctcagcatca ttccaggcac
10681 agaacgccag aaaatggaat ggtgctgttg aatcaacagg ttct
//
```

Nucleotide sequence positions 982-1494 of GenBank accession No. AF206518 (WNV isolate 2741) corresponding to amino acid sequence of WNV E glycoprotein

```
 982 ttggaagga gtgtctggag caacatgggt ggatttggtt
1021 ctcgaaggcg acagctgcgt gactatcatg tctaaggaca agcctaccat cgatgtgaag
1081 atgatgaata tggaggcggc caacctggca gaggtccgca gttattgcta tttggctacc
1141 gtcagcgatc tctccaccaa agctgcgtgc ccgaccatgg gagaagctca caatgacaaa
1201 cgtgctgacc cagcttttgt gtgcagacaa ggagtggtgg acaggggctg gggcaacggc
1261 tgcggactat ttggcaaagg aagcattgac acatgcgcca aatttgcctg ctctaccaag
1321 gcaataggaa gaaccatctt gaaagagaat atcaagtacg aagtggccat ttttgtccat
1381 ggaccaacta ctgtggagtc gcacggaaac tactccacac aggttggagc cactcaggca
1441 gggagattca gcatcactcc tgcagcgcct tcatacacac taaagcttgg agaatatgga
```

FIG. 41

Amino acid sequence of WNV E glycoprotein corresponding to nucleotide sequence positions 982-1494 of GenBank accession No. AF206518 (WNV isolate 2741)

Amino-terminus-
LEGVSGATWVDLVLEGDSCVTIMSKDKPTIDVKMMNMEAANLAEVRSYCYLATVSDLSTKAACPT
MGEAHNDKRADPAFVCRQGVVDRGWGNGCGLFGKGSIDTCAKFACSTKAIGRTILKENIKYEVAI
FVHGPTTVESHGNYSTQVGATQAGRFSITPAAPSYTLKLGE
-carboxy terminus

(171 amino acids)

FIG. 42

Nucleotide sequence positions 7681-10395 of GenBank accession no. AF404756 (WNV isolate 3356) corresponding to amino acid sequence of WNV NS5

```
 7681 ggtggggcaa aaggacgcac cttgggagag gtttggaaag aaagactcaa ccagatgaca
 7741 aaagaagagt tcactaggta ccgcaaagag gccatcatcg aagtcgatcg ctcagcagca
 7801 aaacacgcca ggaaagaagg caatgtcact ggagggcatc cagtctctag gggcacagca
 7861 aaactgagat ggctggtcga acggaggttt ctcgaaccgg tcggaaaagt gattgacctt
 7921 ggatgtggaa gaggcggttg gtgttactat atggcaaccc aaaaaagagt ccaagaagtc
 7981 agagggtaca caaagggcgg tcccggacat gaagagcccc aactagtgca aagttatgga
 8041 tggaacattg tcaccatgaa gagtggggtg gatgtgttct acagaccttc tgagtgttgt
 8101 gacaccctcc tttgtgacat cggagagtcc tcgtcaagtg ctgaggttga agagcatagg
 8161 acgattcggg tccttgaaat ggttgaggac tggctgcacc gagggccaag ggaattttgc
 8221 gtgaaggtgc tctgccccta catgccgaaa gtcatagaga agatggagct gctccaacgc
 8281 cggtatgggg ggggactggt cagaaaccca ctctcacgga attccacgca cgagatgtat
 8341 tgggtgagtc gagcttcagg caatgtggta cattcagtga atatgaccag ccaggtgctc
 8401 ctaggaagaa tggaaaaaag gacctggaag ggaccccaat acgaggaaga tgtaaacttg
 8461 ggaagtggaa ccagggcggt gggaaaacgc ctgctcaact cagacaccag taaaatcaag
 8521 aacaggattg aacgactcag gcgtgagtac agttcgacgt ggcaccacga tgagaaccac
 8581 ccatatagaa cctggaacta tcacggcagt tatgatgtga agcccacagg ctccgccagt
 8641 tcgctggtca atggagtggt caggctcctc tcaaaaccat gggacaccat cacgaatgtt
 8701 accaccatgg ccatgactga cactactccc ttcgggcagc agcgagtgtt caaagagaag
 8761 gtggacacga aagctcctga accgccagaa ggagtgaagt acgtgctcaa cgagaccacc
 8821 aactggttgt gggcgttttt ggccagagaa aaacgtccca gaatgtgctc tcgagaggaa
 8881 ttcataagaa aggtcaacag caatgcagct ttgggtgcca tgtttgaaga gcagaatcaa
 8941 tggaggagcg ccagagaggc agttgaagat ccaaaatttt gggagatggt ggatgaggag
 9001 cgcgaggcac atctgcgggg ggaatgtcac acttgcattt acaacatgat gggaaagaga
 9061 gagaaaaaac ccggagagtt cggaaaggcc aagggaagca gagccatttg gttcatgtgg
 9121 ctcggagctc gctttctgga gttcgaggct ctgggttttc tcaatgaaga ccactggctt
 9181 ggaagaaaga actcaggagg aggtgtcgag ggcttgggcc tccaaaaact gggttacatc
 9241 ctgcgtgaag ttggcacccg gcctgggggc aagatctatg ctgatgacac agctggctgg
 9301 gacacccgca tcacgagagc tgacttggaa aatgaagcta aggtgcttga gctgcttgat
 9361 ggggaacatc ggcgtcttgc cagggccatc attgagctca cctatcgtca caaagttgtg
 9421 aaagtgatgc gcccggctgc tgatggaaga accgtcatgg atgttatctc cagagaagat
 9481 cagaggggga gtggacaagt tgtcacctac gccctaaaca ctttcaccaa cctggccgtc
 9541 cagctggtga ggatgatgga aggggaagga gtgattggcc cagatgatgt ggagaaactc
 9601 acaaaaggga aaggacccaa agtcaggacc tggctgtttg agaatgggga agaaagactc
 9661 agccgcatgg ctgtcagtgg agatgactgt gtggtaaagc ccctggacga tcgctttgcc
 9721 acctcgctcc acttcctcaa tgctatgtca aaggttcgca aagacatcca agagtggaaa
 9781 ccgtcaactg gatggtatga ttggcagcag gttccatttt gctcaaacca tttcactgaa
 9841 ttgatcatga aagatggaag aacactggtg gttccatgcc gaggacagga tgaattggta
 9901 ggcagagctc gcatatctcc aggggccgga tggaacgtcc gcgacactgc ttgtctggct
 9961 aagtcttatg cccagatgtg gctgcttctg tacttccaca gaagagacct gcggctcatg
10021 gccaacgcca tttgctccgc tgtccctgtg aattgggtcc ctaccggaag aaccacgtgg
10081 tccatccatg caggaggaga gtggatgaca acagaggaca tgttggaggt ctggaaccgt
10141 gtttggatag aggagaatga atggatggaa gacaaaaccc cagtggagaa atggagtgac
10201 gtcccatatt caggaaaacg agaggacatc tggtgtggca gcctgattgg cacaagagcc
10261 cgagccacgt gggcagaaaa catccaggtg gctatcaacc aagtcagagc aatcatcgga
10321 gatgagaagt atgtggatta catgagttca ctaaagagat atgaagacac aactttggtt
10381 gaggacacag tactg
```

FIG. 43

Amino acid sequence of WNV NS5 of GenBank accession no. AF404756 (WNV isolate 3356) corresponding to nucleotide sequence positions 7681-10395

Amino terminus-
GGAKGRTLGEVWKERLNQMTKEEFTRYRKEAIIEVDRSAAKHARKEGNVTGGHPVSRGTA
KLRWLVERRFLEPVGKVIDLGCGRGGWCYYMATQKRVQEVRGYTKGGPGHEEPQLVQSYG
WNIVTMKSGVDVFYRPSECCDTLLCDIGESSSSAEVEEHRTIRVLEMVEDWLHRGPREFC
VKVLCPYMPKVIEKMELLQRRYGGGLVRNPLSRNSTHEMYWVSRASGNVVHSVNMTSQVL
LGRMEKRTWKGPQYEEDVNLGSGTRAVGKPLLNSDTSKIKNRIERLRREYSSTWHHDENH
PYRTWNYHGSYDVKPTGSASSLVNGVVRLLSKPWDTITNVTTMAMTDTTPFGQQRVFKEK
VDTKAPEPPEGVKYVLNETTNWLWAFLAREKRPRMCSREEFIRKVNSNAALGAMFEEQNQ
WRSAREAVEDPKFWEMVDEEREAHLRGECHTCIYNMMGKREKKPGEFGKAKGSRAIWFMW
LGARFLEFEALGFLNEDHWLGRKNSGGGVEGLGLQKLGYILREVGTRPGGKIYADDTAGW
DTRITRADLENEAKVLELLDGEHRRLARAIIELTYRHKVVKVMRPAADGRTVMDVISRED
QRGSGQVVTYALNTFTNLAVQLVRMMEGEGVIGPDDVEKLTKGKGPKVRTWLFENGEERL
SRMAVSGDDCVVKPLDDRFATSLHFLNAMSKVRKDIQEWKPSTGWYDWQQVPFCSNHFTE
LIMKDGRTLVVPCRGQDELVGRARISPGAGWNVRDTACLAKSYAQMWLLLYFHRRDLRLM
ANAICSAVPVNWVPTGRTTWSIHAGGEWMTTEDMLEVWNRVWIEENEWMEDKTPVEKWSD
VPYSGKREDIWCGSLIGTRARATWAENIQVAINQVRAIIGDEKYVDYMSSLKRYEDTTLV
EDTVL
-carboxy terminus

(905 amino acids)

FIG. 44

Nucleotide sequence positions 7574-10270 of GenBank accession No. U88535 (DENV-1 isolate "WestPac") corresponding to amino acid sequence of DENV-1 NS5

```
 7574                ggcacgg gagcccaagg ggaaacactg ggagaaaaat ggaaaagaca
 7621 gctaaaccaa ttgagcaagt cagaattcaa cacttacaaa aggagtggga ttatagaggt
 7681 ggatagatct gaagccaaag aggggttaaa aagaggagaa ccgactaaac acgcagtgtc
 7741 gagaggaacg gccaaactga ggtggtttgt ggagaggaac cttgtgaaac cagaagggaa
 7801 agtcatagac ctcggttgtg gaagaggtgg ctggtcatat tattgcgctg ggctgaagaa
 7861 agtcacagaa gtgaaaggat acacgaaagg aggacctgga catgaggaac caatcccaat
 7921 ggcaacctat ggatggaacc tagtaaagct atactccggg aaagatgtat tctttacacc
 7981 acctgagaaa tgtgacaccc tcttgtgtga tattggtgag tcctctccga acccaactat
 8041 agaagaagga agaacgttac gtgttctaaa gatggtggaa ccatggctca gaggaaacca
 8101 attttgcata aaaattctaa atccctatat gccgagtgtg gtagaaactt tggagcaaat
 8161 gcaaagaaaa catggaggaa tgctagtgcg aaatccactc tcaagaaact ccactcatga
 8221 aatgtactgg gtttcatgtg gaacaggaaa cattgtgtca gcagtaaaca tgacatctag
 8281 aatgttgcta aatcgattca caatggctca caggaagcca acatatgaaa gagacgtgga
 8341 cttaggcgct ggaacaagac atgtggcagt agaaccagag gtggccaacc tagatatcat
 8401 tggccagagg atagagaata taaaaaatgg acacaaatca acatggcact atgatgagga
 8461 caatccatac aaaacatggg cctatcatgg atcatatgag gtcaagccat caggatcagc
 8521 ctcatccatg gtcaatggtg tggtgagact gctaaccaaa ccatgggatg tcattcccat
 8581 ggtcacacaa atagccatga ctgacaccac acccttgga caacagaggg tgtttaaaga
 8641 gaaagttgac acgcgtacac caaaagcgaa acgaggcaca gcacaaatta tggaggtgac
 8701 agccaggtgg ttatggggtt ttctctctag aaacaaaaaa cccagaatct gcacaagaga
 8761 ggagttcaca agaaaagtca ggtcaaacgc agctattgga gcagtgttcg ttgatgaaaa
 8821 tcaatggaac tcagcaaaag aggcagtgga agatgaacgg ttctgggacc ttgtgcacag
 8881 agagagggag cttcataaac aaggaaaatg tgccacgtgt gtctacaaca tgatgggaaa
 8941 gagagagaaa aaattaggag agttcggaaa ggcaaaagga agtcgcgcaa tatggtacat
 9001 gtggttggga gcgcgctttt tagagtttga agcccttggt ttcatgaatg aagatcactg
 9061 gttcagcaga gagaattcac tcagtggagt ggaaggagaa ggactccaca aacttggata
 9121 catactcaga gacatatcaa agattccagg gggaaatatg tatgcagatg acacagccgg
 9181 atgggacaca agaataacag aggatgatct tcagaatgag gccaaaatca ctgacatcat
 9241 ggaacctgaa catgccctat tggccacgtc aatctttaag ctaacctacc aaaacaaggt
 9301 agtaagggtg cagagaccag cgaaaaatgg aaccgtgatg gatgtcatat ccagacgtga
 9361 ccagagagga agtggacagg ttggaaccta tggcttaaac accttcacca acatggaggc
 9421 ccaactaata agacaaatgg agtctgaggg aatcttttca cccagcgaat tggaaacccc
 9481 aaatctagcc gaaagagtcc tcgactggtt gaaaaaacat ggcaccgaga ggctgaaaag
 9541 aatggcaatc agtggagatg actgtgtggt gaaaccaatc gatgacagat ttgcaacagc
 9601 cttaacagct ttgaatgaca tgggaaaggt aagaaaagac ataccgcaat gggaaccttc
 9661 aaaaggatgg aatgattggc aacaagtgcc tttctgttca caccatttcc accagctgat
 9721 tatgaaggat gggagggaga tagtggtgcc atgccgcaac caagatgaac ttgtaggtag
 9781 ggccagagta tcacaaggcg ccggatggag cttgagagaa actgcatgcc taggcaagtc
 9841 atatgcacaa atgtggcagc tgatgtactt ccacaggaga gacttgagat tagcggctaa
 9901 tgctatctgt tcagccgttc cagttgattg ggtcccaacc agccgtacca cctggtcgat
 9961 ccatgcccac catcaatgga tgacaacaga agacatgttg tcagtgtgga atagggtttg
10021 gatagaggaa aacccatgga tggaggacaa gactcatgtg tccagttggg aagacgttcc
10081 atacctagga aaaagggaag atcgatggtg tggatcccta ataggcttaa cagcacgagc
10141 cacctgggcc accaacatac aagtggccat aaaccaagtg agaaggctca ttgggaatga
10201 gaattatcta gacttcatga catcaatgaa gagattcaaa aacgagagtg atcccgaagg
10261 ggcactctgg
```

FIG. 45

Amino acid sequence of DENV-1 NS5 of GenBank accession No. U88535 (DENV isolate "WestPac") corresponding to nucleotide sequence positions 7574-10270

Amino terminus-
GTGAQGETLGEKWKRQLNQLSKSEFNTYKRSGIIEVDRSEAKEGLKRGEPTKHAVSRGTA
KLRWFVERNLVKPEGKVIDLGCGRGGWSYYCAGLKKVTEVKGYTKGGPGHEEPIPMATYG
WNLVKLYSGKDVFFTPPEKCDTLLCDIGESSPNPTIEEGRTLRVLKMVEPWLRGNQFCIK
ILNPYMPSVVETLEQMQRKHGGMLVRNPLSRNSTHEMYWVSCGTGNIVSAVNMTSRMLLN
RFTMAHRKPTYERDVDLGAGTRHVAVEPEVANLDIIGQRIENIKNGHKSTWHYDEDNPYK
TWAYHGSYEVKPSGSASSMVNGVVRLLTKPWDVIPMVTQIAMTDTTPFGQQRVFKEKVDT
RTPKAKRGTAQIMEVTARWLWGFLSRNKKPRICTREEFTRKVRSNAAIGAVFVDENQWNS
AKEAVEDERFWDLVHRERELHKQGKCATCVYNMMGKREKKLGEFGKAKGSRAIWYMWLGA
RFLEFEALGFMNEDHWFSRENSLSGVEGEGLHKLGYILRDISKIPGGNMYADDTAGWDTR
ITEDDLQNEAKITDIMEPEHALLATSIFKLTYQNKVVRVQRPAKNGTVMDVISRRDQRGS
GQVGTYGLNTFTNMEAQLIRQMESEGIFSPSELETPNLAERVLDWLKKHGTERLKRMAIS
GDDCVVKPIDDRFATALTALNDMGKVRKDIPQWEPSKGWNDWQQVPFCSHHFHQLIMKDG
REIVVPCRNQDELVGRARVSQGAGWSLRETACLGKSYAQMWQLMYFHRRDLRLAANAICS
AVPVDWVPTSRTTWSIHAHHQWMTTEDMLSVWNRVWIEENPWMEDKTHVSSWEDVPYLGK
REDRWCGSLIGLTARATWATNIQVAINQVRRLIGNENYLDFMTSMKRFKNESDPEGALW
-carboxy terminus

(899 amino acids)

FIG. 46

Nucleotide sequence positions 7570-10269 of GenBank accession No. AF038403 (DENV-2 isolate "New Guinea") corresponding to amino acid sequence of DENV-2 NS5

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7561          g gaactggcaa cataggagag acgcttggag agaaatggaa aagccgattg
7621 aacgcattgg ggaaaagtga attccagatc tacaagaaaa gtggaatcca ggaagtggat
7681 agaaccttag caaaagaagg cattaaaaga ggagaaacgg accatcacgc tgtgtcgcga
7741 ggctcagcaa aactgagatg gttcgtcgag agaaatatgg tcacaccaga agggaaagta
7801 gtggacctcg gttgcggcag aggaggctgg tcatactatt gtgggggact aaagaatgta
7861 agagaagtca aaggcctgac aaaaggagga ccaggacatg aagaacccat ccccatgtca
7921 acatatgggt ggaatctagt acgtcttcaa agtggagttg acgttttctt cactccgcca
7981 gaaaagtgtg acacattgtt gtgtgacata ggggagtcgt caccaaatcc cacggtagaa
8041 gcaggacgaa cactcagagt ccttaactta gtggaaaatt ggttgaacaa caacacccaa
8101 ttttgcataa aggttctcaa cccatacatg ccctcagtca tagaaaaaat ggaagcacta
8161 caaaggaaat atggaggagc cttagtgagg aatccactct cacgaaactc cacacatgag
8221 atgtactggg tatccaatgc ctccgggaac atagtgtcat cagtgaacat gatttcaagg
8281 atgttgatca acagattcac aatgagacac aagaaagcca cttacgagcc agatgtagac
8341 ctcggaagcg gaacccgcaa catcggaatt gaaagtgaga taccaaacct agacataatc
8401 gggaaaagaa tagaaaaaat aaaacaagag catgaaacat catggcacta tgaccaagac
8461 cacccataca aaacgtgggc ttaccatggc agctatgaaa caaaacaaac tggatcagca
8521 tcatccatgg tgaacggagt ggtcagactg ctgacaaaac cttgggacgt cgtccccatg
8581 gtgacacaga tggcaatgac agacacgact ccatttggac aacagcgcgt ttttaaagaa
8641 aaagtggaca cgagaaccca agaaccgaaa gaaggcacaa agaaactaat gaaaatcacg
8701 gcagagtggc tttggaaaga actagggaag aaaaagacac ctaggatgtg cactagagaa
8761 gaattcacaa gaaaggtgag aagcaatgca gccttggggg ccatattcac tgatgagaac
8821 aagtggaagt cggcacgtga ggctgttgaa gatagtaggt tttgggagct ggttgacaag
8881 gaaaggaatc tccatcttga aggaaagtgt gaaacatgtg tgtataacat gatgggaaaa
8941 agagagaaga agctagggga gttcggcaag gcaaaaggca gcagagccat atggtacatg
9001 tggcttggag cacgcttctt agagtttgaa gccctaggat tcttgaatga agatcactgg
9061 ttctccagag agaactcctt gagtggagtg gaaggagaag ggctgcacaa gctaggttac
9121 attttaagag acgtgagcaa gaaagaggga ggagcaatgt atgccgatga caccgcagga
9181 tgggacacaa gaatcacact agaagaccta aaaaatgaag aaatggtaac aaaccacatg
9241 gaaggagaac acaagaaact agccgaggcc attttcaaat taacgtacca aaacaaggtg
9301 gtgcgtgtgc aaagaccaac accaagaggc acagtaatgg atatcatatc gagaagagac
9361 caaagaggta gtggacaagt tggtacctat ggactcaata ctttcaccaa tatggaagcc
9421 caactaatca gacagatgga gggagaagga gtcttcaaaa gcattcagca cctgacagtc
9481 acagaagaaa tcgccgtgca aaactggtta gcaagagtag ggcgcgaaag gttatcaaga
9541 atggccatca gtggagatga ttgtgttgtg aaacctttag atgacaggtt cgcaagcgct
9601 ttaacagctc taaatgacat gggaaaggtt aggaaagaca tacaacaatg ggaaccttca
9661 agaggatgga acgattggac acaagtgccc ttctgttcac accatttcca tgagttaatc
9721 atgaaagacg gccgcgtact tgtagttcca tgcagaaacc aagatgaact gattggtaga
9781 gcccgaattt cccaaggagc tgggtggtct ttgcgagaga cggcctgttt ggggaagtcc
9841 tacgcccaaa tgtggagctt gatgtacttc cacagacgtg acctcaggct ggcggctaat
9901 gctatttgct cggcagtccc atcacattgg gttccaacaa gtagaacaac ctggtccata
9961 cacgccaaac atgaatggat gacaacggaa gacatgctga cagtctggaa cagggtgtgg
10021 attcaagaaa acccatggat ggaagacaaa actccagtgg aatcatggga ggaaatccca
10081 tacttgggga aaagagaaga ccaatggtgc ggctcattga ttgggctaac aagcagggcc
10141 acctgggcaa agaacatcca aacagcaata aatcaagtta gatcccttat aggcaatgag
10201 gaatacacag attacatgcc atccatgaaa agattcagaa gagaagagga agaggcagga
10261 gtcctgtggt
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FIG. 47

Amino acid sequence of DENV-2 NS5 of GenBank accession No. AF038403 (DENV isolate "New Guinea") corresponding to nucleotide sequence positions 7570-10269

Amino terminus-
GTGNIGETLGEKWKSRLNALGKSEFQIYKKSGIQEVDRTLAKEGIKRGETDHHAVSRGSA
KLRWFVERNMVTPEGKVVDLGCGRGGWSYYCGGLKNVREVKGLTKGGPGHEEPIPMSTYG
WNLVRLQSGVDVFFTPPEKCDTLLCDIGESSPNPTVEAGRTLRVLNLVENWLNNNTQFCI
KVLNPYMPSVIEKMEALQRKYGGALVRNPLSRNSTHEMYWVSNASGNIVSSVNMISRMLI
NRFTMRHKKATYEPDVDLGSGTRNIGIESEIPNLDIIGKRIEKIKQEHETSWHYDQDHPY
KTWAYHGSYETKQTGSASSMVNGVVRLLTKPWDVVPMVTQMAMTDTTPFGQQRVFKEKVD
TRTQEPKEGTKKLMKITAEWLWKELGKKKTPRMCTREEFTRKVRSNAALGAIFTDENKWK
SAREAVEDSRFWELVDKERNLHLEGKCETCVYNMMGKREKKLGEFGKAKGSRAIWYMWLG
ARFLEFEALGFLNEDHWFSRENSLSGVEGEGLHKLGYILRDVSKKEGGAMYADDTAGWDT
RITLEDLKNEEMVTNHMEGEHKKLAEAIFKLTYQNKVVRVQRPTPRGTVMDIISRRDQRG
SGQVGTYGLNTFTNMEAQLIRQMEGEGVFKSIQHLTVTEEIAVQNWLARVGRERLSRMAI
SGDDCVVKPLDDRFASALTALNDMGKVRKDIQQWEPSRGWNDWTQVPFCSHHFHELIMKD
GRVLVVPCRNQDELIGRARISQGAGWSLRETACLGKSYAQMWSLMYFHRRDLRLAANAIC
SAVPSHWVPTSRTTWSIHAKHEWMTTEDMLTVWNRVWIQENPWMEDKTPVESWEEIPYLG
KREDQWCGSLIGLTSRATWAKNIQTAINQVRSLIGNEEYTDYMPSMKRFRREEEEAGVLW
-carboxy terminus

(900 amino acids)

FIG. 48